





## Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.



# COTTON AND OTHER MATERIALS PURCHASED BY MANUFACTURERS



## FOR INTERIORS OF PASSENGER CARS





## PREFACE

This report deals with industrial use of cotton and other materials in the interior of passenger cars. The Special Surveys Branch, Standards and Research Division, Statistical Reporting Service assumed major responsibility for the study.

The project was under the general direction of Trienah Meyers. The study director was Harold R. Linstrom, assisted by Carle P. Graffunder. Stewart, Dougall and Associates, Inc., of New York, N. Y., executed the project under contract with the Department of Agriculture. The Stewart Dougall team was headed by Robert E. Gibson, assisted by John L. Dodge.

Earlier studies were made of the 1950 and 1955 model cars, and the results were published in the following reports:

Automobile Manufacturers Discuss Fabrics and  
Fibers for Passenger Cars. Agricultural  
Information Bulletin No. 45, October 1951.  
(Out of print; may be consulted in libraries.)

Fabrics and Fibers for Passenger Cars, Automobile  
Manufacturers' Views, 1955 Compared with 1950.  
Marketing Research Report No. 152, April 1957.

## CONTENTS

	Page
Highlights .....	iii
Principal materials purchased for use in 1961 passenger cars .....	iii
Compact vs. standard-sized cars .....	iii
Styling preferences .....	iv
Desired characteristics .....	iv
Introduction .....	1
How the study was made .....	2

### PART I

Consumption for 1961 model year .....	4
Consumption for selected parts .....	4
Consumption in standard-sized and compact automobiles .....	8
Total poundage by part .....	10
Poundage of individual materials by part .....	14
Comparison of 1961 and 1955 .....	16
Production .....	16
Consumption .....	16

### PART II

How the automobile industry makes decisions on interior trims .....	21
Initial selection .....	22
First style show .....	23
Testing fabrics' suitability .....	23
Second style show .....	24
Implementation of selection .....	25
Materials evaluated for selected parts .....	27
Upholstery materials .....	27
Sidewall materials .....	49
Headlining materials .....	55
Seat cushion and back padding .....	60
Foundation sheeting .....	63
Thermal and sound insulation .....	65
Convertible tops .....	70
Suggestions on ways to improve cotton and wool for use in automobiles .....	73
Appendix .....	80
Explanation of the term "price class of car" .....	80

June 1963

## HIGHLIGHTS

### Principal Materials Purchased for Use in 1961 Passenger Cars

1. Cotton - Cotton's share of the materials used in 1961 passenger car interiors was about the same as it was 6 years earlier (55 percent in 1955 model year, 54 percent in 1961). However, in 1961 purchases of cotton dropped to 15<sup>4</sup> million pounds from the high of 210 million pounds in 1955, due in large part to the 1-1/2-million drop in number of standard cars produced and the large proportion of compacts.

As in 1955, cotton-backed vinyl was the leading material used for upholstery. Vinyl accounted for 46 percent of the upholstery poundage and cotton backing for 20 percent.

Cotton's greatest decline in 1961 was as a backing in sidewalls; from 33 percent in 1955 to 9 percent in 1961. This decrease is the result of increased use of paper and hardbacking. Since 1958, electrolytic bonding of plastic directly to a hardbacking has been widely practiced; thus, hardbacking has replaced a considerable amount of textile backing.

For headlining, cotton was still the leading material, but had declined from 1955 with vinyl and paper showing a definite increase.

The position of cotton for use in seat padding and as foundation sheeting reflects little change from 1955. Cotton is still clearly the leader.

2. Vinyl - Vinyl continued to show an increase both in proportion of poundage purchased and in total poundage. Except for seat padding, where it continued to be used in only negligible amounts, it showed an increase in all applications. In sidewall upholstery, vinyl was the most heavily consumed material. Its use will probably increase.

3. Foams and sponges - Foams and sponges accounted for 11 percent of the total poundage of materials purchased for use in 1961 car interiors. Twenty-nine of the 31 million pounds of these materials went into seat padding. Most of the remainder went into sidewalls. Urethane is expected to move into a stronger position.

4. Burlap, sisal, jute - These three materials combined accounted for 7 percent of the total poundage purchased for the interiors of the 1961 model cars. Most of the 21 million pounds of these materials went into seat padding; the remainder went into upholstery, sidewalls, and sheeting.

### Compact vs. Standard-Sized Cars

In 1961, compact automobiles accounted for more than one-third of the passenger cars produced in the United States. Some materials were used to a

greater or lesser degree in compacts and standards. Among these materials were:

Cotton.--In upholstery, cotton was purchased for use in standards to a somewhat greater extent than in compacts; 28 percent and 24 percent respectively.

For both standard and compact headlinings, cotton accounted for about 50 percent of the material purchased; however, more of the cotton for headlining was used as a backing in compacts than in standard-sized cars.

Cotton accounted for more of the seat padding poundage in compacts (76 percent) than in standard-sized cars (67 percent). Nearly all of the sheeting used in both compacts and standards was cotton.

Vinyl.--Vinyl accounted for 49 percent of total poundage for upholstery in compacts; 45 percent in standard-sized cars.

For sidewalls, it was just the reverse, vinyls accounted for 55 percent in standards and 44 percent in compacts.

There is a more noticeable difference in the figures for headlinings, with vinyls accounting for 40 percent of the poundage in compacts and only 25 percent in standard-sized cars.

Hardbackings.--Of all the materials purchased for use in sidewalls, hardbackings accounted for 60 percent in compacts and 47 percent in standard-sized cars. In headlining, hardbackings accounted for 23 percent of the materials purchased for standards but were not reported used in compacts.

### Styling Preferences

As regards fabric styling (e.g., color - shade - design), there has been a definite change in what the manufacturers desire. In contrast to the 1955 interest in bright, more intense colors with large nongeometric figures and a lustrous sheen, in 1961 auto executives preferred lighter more subdued colors with small three-dimensional designs and a dull sheen. As in 1955, however, flat woven fabrics were still preferred.

### Desired Characteristics

In all five major parts of the interior of both compact and standard-sized cars, "performance over a period of normal use by car owners" was the characteristic considered most desirable. This was followed by "attractiveness to the customer," and "ease of handling in production."

COTTON AND OTHER MATERIALS PURCHASED BY  
MANUFACTURERS FOR INTERIORS OF PASSENGER CARS

INTRODUCTION

This study presents data on the volume of materials used in car interiors 1/ and for convertible tops, and describes opinions and attitudes of key automobile executives about materials purchased for use in passenger car interiors for the 1961 model year. Also, this report compares selected findings regarding 1961 cars with those of an earlier study of 1955 cars (see Preface).

Major changes in styling automobile interiors had taken place since 1955. Accordingly, in October 1961, Secretary of Agriculture Freeman addressed a letter to the presidents of the automobile companies which manufactured closed passenger models. He wrote, in part:

"The automobile industry continues to consume large amounts of fibers of agriculture origin; but changing trends in materials usage, along with the changing requirements based upon increased production of the smaller compact cars, point up the need of producers and manufacturers for further information on current use patterns, changes from past practices, and the opportunity and demand for competing materials."

The main objectives of the 1961 study were:

1. To discover what characteristics manufacturers want and the fabrics used for upholstery, headlining, floor covering, sheeting, seat padding, sidewalls, and convertible tops.
2. To discover what changes are taking place in the use of materials and the reasons for those changes.
3. To discover who makes decisions about materials and what are the bases for decisions.

All companies agreed to cooperate in providing consumption data and time for personal interviews with key executives. Information was obtained from five companies: American Motors, Chrysler, Ford, General Motors, and Studebaker-Packard.

---

1/ The interior includes thermal and sound insulation used in closed passenger cars, upholstery, sidewall, headlining, seat padding, foundation sheeting, and floor covering.

## How the Study was Made

### What was studied

The study had two main parts. In one part quantitative data were collected about kinds and amounts of materials automobile manufacturers used for the interiors of 1961 model passenger cars, both standard and compact. In the second part conferences were held to learn: (1) attitudes and opinions of the auto executives about materials they considered suitable in and used for auto interiors, and (2) how executives decide on materials to be used, (3) trends they expected in the future use of materials for auto interiors.

### Who supplied information

For the first part of this study, each auto company calculated and recorded pounds of every material used in its auto interiors. These records were combined for all companies to produce the consumption tables shown in Part I of this report.

Within each company, executives were interviewed in groups. <sup>2/</sup> Persons providing the information included company and division presidents, stylists, trim engineers, laboratory technicians, purchasing agents, buyers, and product-planning executives. A total of more than 50 auto executives took part in these discussions. Each person talked about those items in the study for which he had some degree of responsibility. For example, key persons in product planning, engineering, and styling were interviewed as a group to find out the part each played in final choices of materials and styling. Group interviews averaged 3-1/2 hours, ranging from 2-1/2 to 9 hours. Some interviews were divided into 2 or more sessions.

### Treatment of results

The analysis and presentation of data obtained in this study pose special problems because of the size and character of the industry involved. That is, the number of companies comprising the universe is 5, a number which does not permit the usual statistical techniques of percentage distributions. Simple presentation of the number of companies with particular preferences or practices would be misleading because of the relatively greater influence of the larger companies. In addition, the case history method could not be used because the organizational structure and policies of each company are often so well known that the anonymity guaranteed could not then be achieved.

Furthermore, with the "conference technique" several executives in one company might be interviewed about the same part of the automobile, if all

---

<sup>2/</sup> This was a departure from the 1955 survey. Comparison of percentages between the two reports is not presented in Part II of this report because of the difference in method of collecting data.

contributed to decisions on that part. Sometimes within one company some differences of opinion were found with respect to preferences, expected trends, and what constituted an ideal material. Moreover, the number of executives interviewed varied from company to company and there was no correlation between the size of a company and the number of interviews.

The procedure followed in 1961 differs from the previous method in that percentages based on the number of respondents were omitted, and group opinions were used instead. There are several reasons for this change. The automotive companies requested that the interviews be conducted with working groups responsible for functions such as styling and product planning in order to demonstrate that a group of men develop final decisions and minimize the duplication of effort by the automotive executives and the consulting firm. As a result, the answers represent group and not individual decisions. Usually the department head led the discussion of each topic and tended to bring into focus the pertinent factors offered by the group members; the response arrived at reflected the thinking of the group as a team. These responses were recorded and later weighted to reflect volume of company production of 1961 passenger cars.

This type of response weighting does not adjust for the evaluation of the number of executives present, or the possible differences of opinion among executives.

Because of this, the percentages in the Part II tables under the heading, "Total Weighted Replies" should be considered more as a ranking and should not be compared with previous studies in which individual experts' opinions were weighted.

Production data by companies indicated that the following weights should be applied to responses from each company.

<u>Company</u>	<u>Percentage of total production of the 5 companies</u>
General Motors -----	47.6
Ford -----	31.4
Chrysler -----	12.8
Studebaker-Packard -----	7.0
American -----	<u>1.2</u>
Total -----	100.0

As in the 1955 study those parts of the analyses which did not lend themselves to statistical analysis have been handled qualitatively, documented by direct quotations.

The number of companies giving a particular response is shown for added clarity.

Of course, the data on consumption, which are complete in themselves, are not weighted.

## PART I

### CONSUMPTION FOR THE 1961 MODEL YEAR

The data collected on consumption of fibers and other materials used in interior parts of automobiles apply to the 1961 model year. At the time of interview, purchasing for the 1961 model year was completed in all five companies and the information is based on records obtained through corporate headquarters from divisions and purchasing departments. Wastage is included in the data.

The automobile manufacturers were provided with a detailed 9 page recording form listing five interior parts of the car, plus convertible tops and insulation materials, presented separately. Specific materials were also listed, with space left for additional unspecified materials which might have come into use since the previous (1955) study.

These forms also provided space for separate entry of data for compact and standard-sized automobiles, and for floor coverings, none of which were included in previous reports. These additional data are presented separately at the end of Part I.

The consumption data have been assembled in terms of total pounds of each fiber contained in the materials purchased. With the exception of padding, figures refer to processed materials. This method of reporting was adopted to conform to the consumption data presented in the 1955 report. The companies also computed amounts of individual fibers or materials when blends or mixtures were involved.

Table 1 presents the specific fibers and materials purchased, poundage for each, and the percent each accounts for of total consumption for the five interior parts--upholstery, sidewalls, headlining, seat padding, and sheeting. Poundage is presented in two ways: (1) total poundage for these parts excluding seat padding, and (2) total poundage including seat padding.

#### Consumption for Selected Parts

In 1961, cotton-backed vinyl was the leading material for upholstery; 46 percent of this poundage was vinyl, while the cotton backing accounted for 20 percent. The only other fibers of any significant volume were rayon and acetate (primarily rayon), and nylon. Rayon and acetate ranked third (10 percent) and nylon fourth (9 percent). Wool accounted for less than one-half percent of the upholstery poundage.

For sidewalls, vinyl accounted for 51 percent of the poundage in 1961 cars. Vinyl was bonded to most of the hardbacking <sup>3/</sup> and cardboard used in

---

<sup>3/</sup> The term hardbacking as used in this report includes paperboard, hardboard, woodfiber, and etc.

Table 1.--Materials purchased for selected parts of 1961 passenger cars

Materials	Upholstery		Sidewall		Headlining 1/		Seat padding		Foundation sheeting		Total, excluding seat padding		Total, including seat padding	
	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.
Cotton .....	14,571,507	27	3,201,255	9	5,499,295	49	126,570,702	70	4,156,237	93	27,428,294	26	153,998,996	54
Backing .....	11,001,602	20	3,050,824	9	3,795,377	34	---	---	---	---	17,847,803	17	17,847,803	6
All other .....	3,569,905	7	150,431	*	1,703,918	15	126,570,702	70	4,156,237	93	9,580,491	9	136,151,193	48
Vinyls .....	25,274,842	46	17,750,159	51	3,237,568	29	1,827,658	1	2,974	*	46,265,543	44	48,093,201	17
Foams and sponges ...	---	---	2,200,523	6	3,506	*	29,108,957	16	---	---	2,204,029	2	31,312,986	11
Burlap, sisal, jute :	1,160,472	2	296,091	1	---	---	18,977,578	11	272,006	6	1,728,569	2	20,706,147	7
Rayons and acetates :	5,394,110	10	1,033,859	3	99,591	1	2,549,497	1	---	---	6,527,560	6	9,077,057	3
Paper .....	936,917	2	7,214,487	21	2,126,607	19	182,405	*	---	---	10,278,011	10	10,460,416	3
Nylon .....	4,869,400	9	108,940	*	15,926	*	---	---	---	---	4,994,266	5	4,994,266	2
Asphalt .....	---	---	1,658,845	5	---	---	---	---	---	---	1,658,845	2	1,658,845	1
Leather 2/ .....	1,468,869	3	20,143	*	---	---	---	---	---	---	1,489,012	1	1,489,012	1
Wool .....	147,016	*	364,403	1	---	---	129,777	*	---	---	511,419	*	641,196	*
Aluminum foil,	---	---	---	---	---	---	---	---	---	---	---	---	---	---
metallic yarn ....	128,059	*	935	*	---	---	---	---	---	---	128,994	*	128,994	*
Other manmade	---	---	---	---	---	---	---	---	---	---	---	---	---	---
materials .....	85,537	*	10,200	*	223,163	2	116,849	*	---	---	318,900	*	435,749	*
Other .....	451,925	1	1,204,737	3	---	---	1,304,918	1	31,235	1	1,687,897	2	2,992,815	1
Total .....	54,488,654	100	35,064,577	100	11,205,656	100	180,768,341	100	4,462,452	100	105,221,339	100	285,989,680	100
Estimated number	---	---	---	---	---	---	---	---	---	---	---	---	---	---
passenger cars ...	5,323,169	---	5,323,169	---	5,022,697	---	5,323,169	---	5,323,169	---	5,323,169	---	5,323,169	---

\*denotes less than 1 percent

1/ Excludes materials used in an estimated 300,472 convertible tops.

2/ Leather figures represent finished product used in automobiles. In the form of hides, considerably greater amounts of leather were used.

Table la.--Materials purchased for selected parts of 1961 standard passenger cars

Materials	Upholstery		Sidewall		Headlining 1/		Seat padding		Foundation sheeting		Total, excluding seat padding		Total, including seat padding	
	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.
Cotton .....	10,593,351	28	2,225,875	9	3,940,296	49	83,331,530	67	2,863,235	99	19,622,757	27	102,954,287	52
Backing .....	7,428,753	20	2,084,085	8	2,575,204	32	---	---	---	---	12,088,042	17	12,088,042	6
All other .....	3,164,598	8	141,790	1	1,365,092	17	83,331,530	67	2,863,235	99	7,534,715	10	90,866,245	46
Vinyls .....	17,274,919	45	13,412,906	53	1,966,789	25	865,598	1	2,468	*	32,657,082	44	33,522,680	17
Foams and sponges ..	---	---	1,745,861	7	3,506	*	23,179,389	19	---	---	1,749,367	2	24,928,756	13
Burlap, sisal, jute ..	650,435	2	285,291	1	---	---	13,166,713	11	---	---	935,726	1	14,102,439	7
Rayons and acetates ..	3,764,747	10	834,741	4	---	---	1,908,564	1	---	---	4,599,488	6	6,508,052	3
Paper .....	161,488	1	3,614,381	15	2,126,607	26	144,945	*	---	---	5,902,476	8	6,047,421	3
Nylon .....	3,528,747	9	102,225	*	15,926	*	---	---	---	---	3,646,898	5	3,646,898	2
Asphalt .....	---	---	1,566,008	6	---	---	---	---	---	---	1,566,008	2	1,566,008	1
Leather 2/ .....	1,468,869	4	20,143	*	---	---	---	---	---	---	1,489,012	2	1,489,012	1
Wool .....	142,197	*	277,984	1	---	---	75,926	*	---	---	420,181	1	496,107	*
Aluminum foil and metallic yarn .....	104,726	*	935	*	---	---	---	---	---	---	105,661	*	105,661	*
Other manmade materials .....	85,537	*	6,195	*	---	---	88,569	*	---	---	91,732	*	180,301	*
Other .....	333,374	1	1,072,483	4	---	---	948,169	1	23,375	1	1,429,132	2	2,377,301	1
Total .....	38,108,390	100	25,164,928	100	8,053,124	100	123,709,403	100	2,889,078	100	74,215,520	100	197,924,923	100
Estimated number passenger cars ....	3,470,700		3,470,700		3,185,127		3,470,700		3,470,700		3,470,700		3,470,700	

\*Notes less than 1 percent

1/ Excludes materials used in an estimated 285,573 convertible tops.

2/ See table 1.

Table lb.--Materials purchased for 1961 compact passenger cars

Materials	Upholstery		Sidewall		Headlining 1/		Seat padding		Foundation sheeting		Total, excluding seat padding		Total, including seat padding	
	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.	Lbs.	Pct.
Cotton .....	3,978,156	24	975,380	10	1,558,999	50	43,329,172	76	1,293,002	82	7,805,537	25	51,044,709	58
Backing .....	3,572,849	22	966,739	10	1,220,173	39	---	---	---	---	5,759,761	19	5,759,761	7
All other .....	405,307	2	8,641	*	338,826	11	43,239,172	76	1,293,002	82	2,045,776	6	45,284,948	51
Vinyls .....	7,999,923	49	4,337,253	44	1,270,779	40	962,060	2	506	*	13,608,461	44	14,570,521	17
Foams and sponges ..	---	---	454,662	5	---	---	5,929,568	10	---	---	454,662	2	6,384,230	7
Burlap, sisal, jute ..	510,037	3	10,800	*	---	---	5,810,865	10	272,006	17	792,843	3	6,603,708	7
Rayons and acetates ..	1,629,363	10	199,118	2	99,591	3	640,933	1	---	---	1,928,072	6	2,569,005	3
Paper .....	775,429	5	3,600,106	36	---	---	37,460	*	---	---	4,375,535	14	4,412,995	5
Nylon .....	1,340,653	8	6,715	*	---	---	---	---	---	---	1,347,368	4	1,347,368	2
Asphalt .....	---	---	92,837	1	---	---	---	---	---	---	92,837	*	92,837	*
Wool .....	4,819	*	86,419	1	---	---	53,851	*	---	---	91,238	*	145,089	*
Aluminum foil and metallic yarn .....	23,333	*	---	---	---	---	---	---	---	---	23,333	*	23,333	*
Other manmade materials .....	---	---	4,005	*	223,163	2/7	28,280	*	---	---	227,168	1	255,448	*
Other .....	118,551	1	132,354	1	---	---	356,749	1	7,860	1	258,765	1	615,514	1
Total .....	16,380,264	100	9,899,649	100	3,152,532	100	57,058,938	100	1,573,374	100	31,005,819	100	88,064,757	100
Estimated number passenger cars .....	1,852,469		1,852,469		1,837,570		1,852,469		1,852,469		1,852,469		1,852,469	

\*Denotes less than 1 percent

1/ Excludes materials used in an estimated 14,899 convertible tops.

2/ All glass fiber.

this part of the automobile interior. Some vinyl, however, was not electrolytically bonded, in which case it was generally backed with cotton. Cotton for sidewalls constituted 9 percent of the sidewall poundage in 1961; nearly all of this was used for backing rather than for surface material. Designed, plasticized paperboard, used with bonded vinyl surfacing, accounted for 21 percent of sidewall materials.

Although hard-backing materials have always been used in sidewalls, hard-backings were not reported in previous studies because in those years surface materials were not bonded to the hard back, and manufacturers reported only the fabric covering, not the hardbacking which they considered a separate item. Since 1958, electrolytic bonding of plastics directly to hardbacking has been widely practiced. Thus, hardbacking has replaced a considerable amount of textile backing because the surface material and backing are a single unit. Because of these factors, the auto industry included hardbacking as part of the materials reported in 1961 passenger car interiors. To preserve comparability with the 1955 study in which hardbacking was not reported, the 1961 study excludes this type of material from the major consumption tables and reports it separately (table 2). By weight, hardbacking accounted for 52 percent of all materials used for sidewalls.

For headlining, cotton was by far the leading material (49 percent), but vinyl and paper were important constituents in this application (table 1). Again, it should be noted that hardbacking appears in headlining in the 1961 model year for the first time, but unlike sidewalls, hardbacked headlinings are not generally surfaced with plastic materials, although they may be spray painted.

For seat padding, cotton was again a clear leader, accounting for 70 percent of this poundage (table 1). Total foam and sponge usage was 16 percent in 1961.

Cotton is almost the only fiber used in foundation sheeting, 93 percent of all poundage being cotton.

For all five parts combined, cotton accounted for 54 percent of the poundage used in 1961 model cars. About 6 percent of this cotton was used for vinyl backing. Vinyl and "foams and sponges" were second and third: 17 percent and 11 percent respectively (table 1). By weight, hardbacking accounted for 12 percent of the total poundage (table 2).

When seat padding is excluded, cotton (fabric made from lint cotton) accounted for only 26 percent of poundage used in 1961 cars. Vinyl ranked first with 44 percent, followed by cotton, then by paper with 10 percent and by rayon with 6 percent (table 1). By weight, hardbacking represented 28 percent of the poundage of all materials for applications other than seat padding (table 2).

#### Consumption in Standard-Sized and Compact Automobiles

Data on materials consumed in standard-sized and compact automobiles were collected separately in 1961 because compact automobiles had grown in importance

Table 2.--Hardbacking purchased for selected parts of 1961 standard and compact passenger cars 4/

Type of car and interior part	All materials, including hardbacking		Hardbacking	
	Quantity purchased		Quantity purchased	Percentage of all materials purchased
	Pounds		Pounds	Percent
All cars:				
Upholstery .....	54,669,943		181,289	*
Sidewall .....	72,725,758		37,661,181	52
Headlining <u>1/</u> .....	13,589,906		2,384,250	18
Foundation sheeting ..	4,462,452		---	---
Total excluding seat padding ..	145,448,059		40,226,720	28
Seat padding .....	180,931,186		162,845	*
Total including seat padding ..	326,379,245		40,389,565	12
Standard-sized cars:				
Upholstery .....	38,289,679		181,289	1
Sidewall .....	47,760,327		22,595,399	47
Headlining <u>2/</u> .....	10,437,374		2,384,250	23
Foundation sheeting ..	2,889,078		---	---
Total excluding seat padding .....	99,376,458		25,160,938	25
Seat padding .....	123,775,797		66,394	*
Total including seat padding .....	223,152,255		25,227,332	11
Compact cars:				
Upholstery .....	16,380,264		---	---
Sidewall .....	24,965,431		15,065,782	60
Headlining <u>3/</u> .....	3,152,532		---	---
Foundation sheeting ..	1,573,374		---	---
Total excluding seat padding .....	46,071,601		15,065,782	33
Seat padding .....	57,155,389		96,451	*
Total including seat padding .....	103,226,990		15,162,233	15

\*Denotes less than 1 percent

1/ Excludes materials used in an estimated 300,472 convertible tops.

2/ Excludes materials used in an estimated 285,573 convertible tops.

3/ Excludes materials used in an estimated 14,899 convertible tops.

4/ Includes paperboard, hardboard, woodfiber, etc.

and accounted for over one-third of the total number of automobiles produced for that model year (tables 1a, 1b, and 2).

Among the notable differences in the relative importance of materials used for different types of cars are the following.

Upholstery: Cotton was used to a somewhat greater extent in standard-sized automobile upholstery than in the compacts--28 percent and 24 percent respectively (tables 1a, 1b). Moreover, about 30 percent of upholstery cotton used in standard cars was in surface material rather than as backing for vinyl, whereas in the compacts nearly 10 percent of the cotton used in upholstery was utilized in surface materials.

Sidewalls: In sidewalls, vinyls accounted for the largest part of materials both in compact cars (44 percent) and in standard-sized cars (53 percent). Paper was a more important constituent in compact sidewalls (36 percent) than in standard-sized cars (15 percent). In all cars, the amount of hardbackings purchased for use in sidewalls was substantial (table 2). By weight, hardbackings accounted for a larger part of sidewall materials in compact cars (60 percent) than in standard-sized cars (47 percent).

Headlinings: In both standards and compacts, cotton constituted about 50 percent of the headlining materials (tables 1a, 1b). More of the cotton for headlining was used as backing for vinyl in the compacts than in standard-sized cars, and vinyls accounted for 40 percent of the poundage in compact headlining as compared to 25 percent in the standards. Paper constituted a considerable portion of the headlining in standard-sized cars (26 percent) but was not reported for compacts. In contrast, glass fiber headlining was reported only for compacts (7 percent). By weight, hardbackings were 23 percent of the headlining for standard cars; no hardbackings were reported for compacts (table 2).

Seat Padding: In seat padding, more "foams and sponges" were utilized in standard-sized cars than in compacts (19 percent as compared to 10 percent) (tables 1a, 1b). As a result, cotton formed a larger part of compact seat padding (76 percent) than of standard-sized automobile padding (67 percent).

Foundation Sheeting: In the sheeting category, cotton was used in virtually all of the standards whereas compacts utilized 82 percent cotton and 17 percent jute.

#### Total Poundage by Part

This section presents the data in two ways: total poundage of "all materials" purchased for the major parts of 1961 passenger car interiors, and the poundage of selected materials in each of the major parts (tables 3, 3a, and 3b).

The auto industry purchased 326,379,245 pounds of materials (including hardbacking) for the interior parts of 1961 closed passenger cars. Of this

Table 3.--Percentage of individual materials purchased for use in specified parts of 1961 passenger cars

Material	Total	Upholstery	Sidewall	Headlining	Seat padding	Foundation	Total
	Pounds	Percent	Percent	Percent	Percent	Percent	Percent
Cotton .....	153,998,996	9	2	4	82	3	100
Backing .....	17,847,803	62	17	21	---	---	100
All other .....	136,151,193	3	*	1	93	3	100
Vinyls .....	48,093,201	52	37	7	4	*	100
Foams and sponges	31,312,986	---	7	*	93	---	100
Burlap, sisal, jute .....	20,706,147	6	1	---	92	1	100
Rayons and acetates .....	9,077,057	60	11	1	28	---	100
Paper .....	10,460,416	9	69	20	2	---	100
Nylons .....	4,994,266	98	2	*	---	---	100
Asphalt .....	1,658,845	---	100	---	---	---	100
Leather .....	1,489,012	99	1	---	---	---	100
Wool .....	641,196	23	57	---	20	---	100
Aluminum foil, metallic yarn ..	128,994	99	1	---	---	---	100
Other manmade material .....	435,749	20	2	51	27	---	100
Miscellaneous .....	2,992,815	15	40	---	44	1	100
Total .....	285,989,680	19	12	4	63	2	100
Hardbacking .....	40,389,565	1	93	6	*	---	100
All materials .....	326,379,245	17	22	4	56	1	100

\*Denotes less than 1 percent

1/ Excludes material used in an estimated 300,472 convertible tops.

Table 3a.--Percentage of individual materials purchased for use in specified parts of 1961 passenger cars

Material	Total	Upholstery	Sidewall	Headlining	Seat padding	Foundation	Total
				1/		sheeting	
	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Cotton .....	102,954,287	10	2	4	81	3	100
Backing .....	12,088,042	62	17	21	---	---	100
All other .....	90,866,245	3	*	2	92	3	100
Vinyls .....	33,522,680	51	40	6	3	*	100
Foams and sponges ..	24,928,756	---	7	*	93	---	100
Burlap, sisal, jute .....	14,102,439	5	2	---	93	---	100
Rayons and acetates .....	6,508,052	58	13	---	29	---	100
Paper .....	6,047,421	3	60	35	2	---	100
Nylons .....	3,646,898	97	3	*	---	---	100
Asphalt .....	1,566,008	---	100	---	---	---	100
Leather .....	1,489,012	99	1	---	---	---	100
Wool .....	496,107	29	56	---	15	---	100
Aluminum foil, metallic yarn ...	105,661	99	1	---	---	---	100
Other manmade material .....	180,301	48	3	---	49	---	100
Miscellaneous .....	2,377,301	14	45	---	40	1	100
Total .....	197,924,923	19	13	4	63	1	100
Hardbacking .....	25,227,332	1	90	9	*	---	100
All materials .....	223,152,255	17	22	5	55	1	100

\*Denotes less than 1 percent

1/ Excludes material used in an estimated 285,573 convertible tops.

Table 3b.--Percentage of individual materials purchased for use in specified parts of 1961 passenger cars

Material	Total	Upholstery	Sidewall	Headlining	Seat padding	Foundation	Total
				1/		sheeting	
	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Cotton .....	51,044,709	8	2	3	85	2	100
Backing .....	5,759,761	62	17	21	---	---	100
All other .....	45,284,948	1	*	1	95	3	100
Vinyls .....	14,570,521	55	30	9	6	*	100
Foams and sponges ..	6,384,230	---	7	---	93	---	100
Burlap, sisal, jute .....	6,603,708	8	*	---	88	4	100
Rayons and acetates .....	2,569,005	63	8	4	25	---	100
Paper .....	4,412,995	17	82	---	1	---	100
Nylons .....	1,347,368	99	1	---	---	---	100
Asphalt .....	92,837	---	100	---	---	---	100
Wool .....	145,089	3	60	---	37	---	100
Aluminum foil, metallic yarn .....	23,333	100	---	---	---	---	100
Other manmade materials .....	255,448	---	2	87	11	---	100
Miscellaneous .....	615,514	19	22	---	58	1	100
Total .....	88,064,757	19	11	3	65	2	100
Hardbacking .....	15,162,233	---	99	---	1	---	100
All materials .....	103,226,990	16	24	3	55	2	100

\*Denotes less than 1 percent

1/ Excludes material used in an estimated 14,889 convertible tops.

amount, 68 percent was for use in standard-sized cars and 32 percent in compacts. Excluding 40,389,656 pounds of hardbacking, the remaining materials weighed 285,989,680 pounds. Sixty-nine percent was used in standards and 31 percent in compacts.

When the pounds of materials purchased for compacts and standards are separated, distribution of materials in the five major parts of the interior is substantially the same for both kinds of cars. This was true whether hardbackings were included or excluded.

More pounds of materials were used in seat padding than in all other interior parts combined. Hardbackings excluded, seat padding was 63 percent of interior poundage in all cars (table 3). The main effect of excluding hardbackings from the base poundage is to increase (from 56 to 63 percent) the percentage of weight attributed to seat padding and to decrease (from 22 to 12 percent) the percentage of weight attributed to sidewalls (table 3).

With or without hardbacking, the poundage in upholstery in both compacts and standards is about the same proportion (19 percent) of their interior weight.

Sidewall materials were 13 percent of interior poundage in standard autos and 11 percent in compacts.

#### Poundage of Individual Materials by Part

Cotton: Nearly 154 million pounds of cotton were purchased for use in the interiors of 1961 cars. Eighty-two percent was for use in seat padding, 9 percent in upholstery, 4 percent in headlining, 3 percent in sheeting, and 2 percent in sidewalls (table 3). Although the general pattern of use was similar for standards and compacts, a slightly smaller percentage of the cotton went into seat padding in standards than in compacts, and a slightly larger percentage of cotton went into upholstery of standards than of compacts (tables 3a, 3b).

Of the total, nearly 18 million pounds of cotton was purchased for backing. Sixty-two percent of the backing cotton went into upholstery, 21 percent into headlining, and 17 percent into sidewalls. These percentages were identical for standards and compacts.

For uses other than backing the auto companies bought more than 136 million pounds of cotton for 1961 cars. On the average, 93 percent of this cotton was used in seat padding, 3 percent in upholstery, and 3 percent in sheeting. A greater percentage of this cotton in compacts than in standards was used as seat padding. But the percentage in upholstery was somewhat greater in standards than in compacts.

Vinyls: More than 48 million pounds of vinyls were bought to use in 1961 passenger car interiors. The major portion of this poundage was for use in upholstery (52 percent) and sidewalls (37 percent). Smaller amounts went into headlining (7 percent) and seat padding (4 percent).

Of the vinyl poundage purchased for standard-sized cars, 40 percent was in sidewalls and 51 percent in upholstery. In compact cars, 30 percent of the vinyl went into sidewalls and 55 percent into upholstery. A greater percentage of vinyls made up headlining and seat padding in compacts than in standards.

Hardbackings: Almost the entire poundage (93 percent) of hardbacking was for use in sidewalls during the 1961 model year. Headlining consumed only 6 percent and small amounts were in upholstery and seat padding.

Hardbackings were more important in sidewalls of compacts (99 percent) than of standards (90 percent), but more important in headlining of standards (9 percent) than of compacts (none reported). About 1 percent of the hardbacking in standards was in upholstery; none was in compacts. Both sizes of automobiles used some hardbackings in seat padding.

Foams and sponges: There was no difference in the percentages of foams and sponges in the five interior parts of standard and compact cars. Both used 93 percent of the poundage in seat padding and 7 percent in sidewalls. Some of these products were in the headlining of standard-sized cars.

Burlap, sisal, jute: Nearly 21 million pounds of burlap, sisal, and jute were purchased for 1961 autos. Ninety-two percent went into seat padding and 6 percent (all of which was jute) in upholstery. Some use was made of these fibers in sidewalls and foundation sheeting.

Whereas 93 percent of the poundage in standard-sized cars was in seat padding, only 88 percent of the poundage in compacts was in seat padding. None of these three fibers were for use in sheeting for standard-sized cars, but 4 percent of the poundage of burlap, sisal, and jute in compacts was for sheeting. A greater percentage (8 percent) was for upholstery in compacts than in standards (5 percent). Both sizes of cars used some of at least one of these items in sidewalls.

Rayons and acetates: About 9 million pounds of these fibers were purchased for use in 1961 passenger automobiles, 60 percent for upholstery, 28 percent for seat padding, 11 percent for sidewalls, and 1 percent for headlining. Rayons and acetates for upholstery were used to a greater extent (63 percent) in compacts than in standards (58 percent). Standards, however, made greater use of such fibers in seat padding and sidewalls than did compacts. Only compacts used rayons and acetates in headlining.

Paper: Of more than 10 million pounds of paper, 69 percent was purchased for use in sidewalls, 20 percent in headlining, 9 percent in upholstery, and 2 percent in seat padding.

Although both standards and compacts used the greatest proportion of their paper in sidewalls, and although each used but small proportions in seat padding, differences in the percent of paper used in the other parts of the interior are striking. For example, 35 percent of the paper for use in standards was for headlining; no paper went into headlining for compacts. Seventeen percent of the paper in compacts was for upholstery, 3 percent in standards was for upholstery.

Of all the materials used in sidewalls, paper made up 82 percent in compacts but only 60 percent in standards.

Nylon: Almost all the 5 million pounds of nylon went into upholstery. Small amounts were used in sidewalls (3 percent in standards, 1 percent in compacts), and a negligible amount was used in the headlining of some standard cars.

Asphalt: Nearly 95 percent of the 1.7 million pounds of asphalt which the automobile companies bought for use in 1961 cars, went into standard-sized models. In both standards and compacts, all the asphalt was used in sidewalls. (See table 6 for asphalt in insulation.)

Leather: All of the 1.5 million pounds of leather went into standard-sized cars in 1961. Ninety-nine percent was used in upholstery and the remaining 1 percent in sidewalls.

Wool: The auto industry bought somewhat more than one-half million pounds of wool for use in 1961 model cars. About 57 percent went into sidewalls, 23 percent into upholstery, and 20 percent into seat padding. The major difference in use between compact and standard-sized cars was in upholstery and seat padding applications. Whereas wool accounted for 29 percent of the upholstery in standards, it accounted for only 3 percent in compacts. And in compacts, 37 percent of the wool was seat padding whereas in standards 15 percent of the wool was seat padding.

Aluminum foil and metallic yarns: All products of this type went almost exclusively into upholstery. The single exception is that a small amount (1 percent) was used in sidewalls of standards.

## COMPARISON OF 1961 AND 1955 <sup>4/</sup>

### Production

Nearly 7 million passenger cars were produced in 1955 by the companies included in our study. Production in 1961 dropped to about 5-1/2 million. Differences in poundage figures for materials used in auto interiors are a reflection, in part, of the sizable difference in level of production between the two periods and the large production (nearly 2 million) of compact cars.

### Consumption

Some changes have taken place since 1955 in the proportions of different materials used in automobile interiors, particularly in those used for sidewalls, headlining, and seat padding (table 4). In 1961, vinyls accounted for

---

<sup>4/</sup> Production figures reported here are lower than those published by industry itself because small companies and specialty companies were not included in these studies.

Table 4.--Materials purchased for use in selected 1955 and 1961 car parts as a percentage of total materials in each part

Materials	Upholstery		Sidewall		Headlining		Seat padding		Foundation sheeting		Total excluding seat padding		Total including seat padding	
	1961	1955	1961	1955	1961	1955	1961	1955	1961	1955	1961	1955	1961	1955
Cotton .....	27	28	9	50	49	76	70	61	93	99	26	43	54	95
Backing .....	20	20	9	33	34	8	---	---	---	---	17	22	6	7
All other .....	7	8	*	17	15	68	70	61	93	99	9	21	48	48
Vinyl .....	46	40	51	42	29	14	1	2	*	---	44	36	17	13
Foam and sponge 1/ .....	---	---	6	---	*	---	16	22	---	---	2	---	11	15
Burlap, sisal jute .....	2	1	1	*	---	---	11	14	6	1	2	*	7	10
Rayon and acetate .....	10	13	3	6	1	*	1	*	---	---	6	9	3	3
Paper .....	2	*	21	---	19	9	*	---	---	---	10	1	3	*
Nylon .....	9	10	*	1	*	*	---	*	---	---	5	6	2	2
Asphalt .....	---	*	5	---	---	---	---	---	---	---	2	*	1	*
Leather .....	3	5	*	---	---	---	---	---	---	---	1	3	1	1
Wool .....	*	1	1	1	---	1	*	*	---	---	*	1	*	*
Aluminum foil, metallic yarn 2/ .....	*	1	*	*	---	---	---	---	---	---	*	1	*	*
All other .....	1	1	3	---	2	*	1	1	1	---	2	*	1	1
Total .....	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Poundage (hard-backing excluded):	54,488,654	35,064,577	11,205,656	180,768,341	4,462,452	105,221,339	285,989,680							
	70,151,024	36,173,064	14,995,196	257,988,504	4,516,720	125,836,004	383,824,508							

\*Denotes less than 1 percent

1/ Foam rubber only in 1955.

2/ Metallic yarn only in 1955.

17 percent of all materials used in interiors; in 1955 vinyls were 13 percent. Paper was 3 percent in 1961 but less than 1 percent in 1955. Burlap, sisal, and jute as a group, 7 percent in 1961, were 10 percent in 1955. Another change occurred in foams and sponges which were 11 percent in 1961 but 15 percent of all materials in 1955.

In both years, cotton accounted for more than half the total poundage of materials used in automobile interiors (55 percent in 1955, 54 percent in 1961). Although cotton's proportion of all materials used in passenger car interiors was substantially the same in 1961 as in 1955, there was a considerable shift in the usage to which cotton was put. The level was about the same for upholstery, down considerably for headlining, and down very substantially for sidewalls.

In 1955, 50 percent of the sidewall poundage was cotton, two-thirds of it for vinyl backing. In 1961, only 9 percent was cotton, virtually all of which was used to back vinyl. Cotton also decreased from 76 to 49 percent of the headlining poundage between 1955 and 1961. Moreover, its application in this end-use also changed. Whereas in 1955 cotton was principally a surface material where utilized for headlining, its 1961 application was predominantly as backing for vinyl.

Vinyl increased from 40 to 46 percent of the upholstery poundage between 1955 and 1961. During the same period, its position in sidewalls increased from 42 to 51 percent. Vinyl also increased from 14 percent of the 1955 headlining poundage to 29 percent of 1961 usage in this application.

Hardback headlining appeared as a factor for the first time in 1961, accounting for 17 percent of the poundage, while paper grew from 9 to 19 percent in the same interval.

In seat padding, use of foam rubber has decreased since 1955. Rubber's decline from 22 percent in 1955 to 16 percent in 1961 is largely attributable to the appearance of polyurethane foam. The latter material was not in use in 1955. An increase in cotton is noted between the two periods. This material remained the predominant seat padding constituent (70 percent).

A change is noted between 1961 and 1955 in the materials and quantity of materials used in foundation sheeting. Whereas cotton constituted 99 percent of the 1955 sheeting poundage, this dropped to 93 percent in 1961 in a shift to jute. Moreover, unlike all other categories, the absolute poundage for sheeting increased despite a decrease in the number of cars produced. This increase arises principally from the far greater use in 1961 of pleated materials requiring foundation sheet inserts. It is also possible that some sheeting supplied to manufacturers as a container for pads was not reported separately in 1955 whereas it was in 1961.

### Convertible tops

Although there was a decrease in total automobile production between 1955 and 1961, more convertibles were made during the 1961 model year than in 1955--300,472 as compared with 197,291. With the increase in production of

convertibles between the two survey years, the consumption of cotton for soft tops nearly doubled. In 1961, quite unlike 1955, all the cotton went into backing for vinyl. This change in the use of cotton reflects a shift in emphasis from latex-bonded cotton tops to cotton-backed vinyl. Vinyl poundage increased about five times between the two periods. A few materials which were not reported in 1955--polyethylene, nylon, and glass fiber--appeared as minor factors in 1961 convertible tops (table 5).

Table 5.--Materials purchased for convertible tops  
of 1961 and 1955 passenger cars

Material	Quantity		Percentage	
	1961	1955	1961	1955
	<u>Pounds</u>	<u>Pounds</u>	<u>Percent</u>	<u>Percent</u>
Cotton .....	2,353,536	1,214,023	39	43
Vinyl .....	1,640,379	334,859	27	12
Latex <sup>1/</sup> .....	1,401,172	992,558	24	35
Jute .....	378,212	224,053	6	8
Polyethylene .....	153,058	---	3	---
Nylon .....	39,910	---	1	---
Glass fiber .....	18,810	---	*	---
Rayon .....	15,510	44,919	*	1
Acrylic fiber .....	---	19,147	---	1
Total .....	6,000,587	2,829,559	100	100

\*Less than 1 percent.

<sup>1/</sup> Latex and butyl in 1955.

### Insulation

In 1961 for the first time, detailed information was obtained on poundage of materials purchased for insulation in passenger cars. The poundage figures refer to all applications including roof, floor, underbody, door panels, cowl, and hood.

It is estimated that the total consumption of insulation materials was 109,981,757 pounds for 1961 automobiles. Of this poundage, asphalt accounted for 35 percent, paper for 26 percent, felts for 12 percent, mastics for 10 percent, glass fibers for 8 percent, cotton for 4 percent, and wood fibers for 3 percent. Other materials used included jute, synthetics, and rubber (table 6).

The major insulation materials in standard-sized autos were the same as those in compacts. However, the compacts' use of asphalt was 38 percent, of paper and paperboard 19 percent, of felts and mastics 13 percent each. By comparison the standard-sized automobiles' use of asphalt was 33 percent, of paper and paperboard 29 percent, of felts 12 percent, of mastics 9 percent.

Table 6.--Materials purchased for insulation in standard and compact 1961 passenger cars

Materials	Total		Standard cars		Compact cars	
	<u>Lbs.</u>	<u>Pct.</u>	<u>Lbs.</u>	<u>Pct.</u>	<u>Lbs.</u>	<u>Pct.</u>
Asphalt .....	38,460,006	35	24,542,379	33	13,917,627	38
Paper and paperboard ....	28,311,515	26	21,240,959	29	7,070,556	19
Felts .....	13,645,363	12	9,047,737	12	4,597,626	13
Mastic(s) .....	11,349,456	10	6,505,549	9	4,843,907	13
Glass fibers ....	8,932,388	8	5,524,787	8	3,407,601	9
Cotton .....	3,861,176	4	2,901,824	4	959,352	3
Wood fiber .....	3,527,716	3	2,219,626	3	1,308,090	4
Jute .....	727,108	1	727,108	1	---	---
All other .....	1,167,029	1	993,477	1	173,552	1
Total .....	109,981,757	100	73,703,446	100	36,278,311	100

Table 7.--Materials purchased for floor covering (carpeting) in standard and compact 1961 passenger cars

Materials	Total		Standard cars		Compact cars	
	<u>Lbs.</u>	<u>Pct.</u>	<u>Lbs.</u>	<u>Pct.</u>	<u>Lbs.</u>	<u>Pct.</u>
Rubber .....	66,110,495	45	38,067,310	38	28,043,185	58
Jute .....	48,447,001	33	33,157,510	33	15,289,491	31
Rayons and acetates .....	17,533,663	12	14,389,157	15	3,144,506	7
Latex .....	9,231,563	6	7,690,439	8	1,541,124	3
Burlap .....	2,179,574	1	1,794,513	2	385,061	1
Polyethylene ....	2,067,400	1	2,032,500	2	34,900	*
Nylon .....	1,299,022	1	1,244,188	1	54,834	*
Vinyl .....	821,470	1	753,796	1	67,674	*
Cotton (backing):	121,069	*	70,314	*	50,755	*
Total .....	147,811,257	100	99,199,727	100	48,611,530	100

\*Denotes less than 1 percent

## Floor covering (carpeting)

Detailed information on individual materials and poundages of each used in floor covering, presented for the first time in this report, shows consumption of 147,811,257 pounds of materials in the 1961 model year. Rubber accounted for 45 percent of total poundage, jute for 33 percent, rayon for 12 percent, and latex for 6 percent. The remaining 4 percent comprised burlap, polyethylene, nylon, vinyl, and cotton.

In compact and standard autos, the individual materials reported for floor coverings were the same, but the percentage of rubber for use in compacts (58 percent) was greater than in standard-sized automobiles (38 percent). In standards, rayon and latex were each used in proportions more than twice that used in compacts (table 7).

## PART II

### HOW THE AUTOMOBILE INDUSTRY MAKES DECISIONS ON INTERIOR TRIMS

As in the 1955 study, a line of inquiry followed with automobile executives in 1961 was designed to determine the methods they used to evaluate and select the fabrics for car interiors. This was done to better understand the competitive position of particular fibers or materials.

The participating executives were asked to describe in some detail their part in making decisions pertaining to the selection of specific materials for car trim purposes. All those acknowledging active participation in the selection of materials for car interiors were asked:

"The previous study showed that many people were involved in selecting upholstery and other fabrics. We would like to discuss how your company selected fabrics for its 1961 models. How did your company go about this selection process in 1961?"

The interviewers, in this phase of the study, were instructed to draw out the respondents on such matters as who determines price ranges and type and style of fabrics to be used, who makes initial and final selections, and who controls decisions based on performance tests.

In general, the selection process changed very little between 1955 and 1961. Consistent with the findings of the earlier survey, the details involved in selecting interior fabrics in 1961 varied only slightly among the various companies. Depending upon the size of the company, there were some variations primarily in the scope of the selection process and in the degree of emphasis placed upon certain stages.

Both surveys revealed that persons within any one company who influenced some phase of fabric selection numbered from dozens to hundreds. Obviously the degree of influence of each person in the selection process varied greatly

according to his function and position; but indications are that each opinion expressed was carefully considered.

The typical flow of activity which constituted the selection process during the 1961 model year falls into the following 5 stages:

### 1. Initial Selection

As much as a year and a half to two years before a car was produced, the chief stylists and trim engineers of the automobile industry began to accumulate numerous samples of trim fabrics of every conceivable type and style. The mills played an important part in this initial phase of trim selection. Automotive companies relied heavily on the mills to anticipate fabric needs by keeping abreast of the public's taste. In addition, the stylists visited fashion and furniture designers with whom the textile industry was continually working. The automotive executives believed that trends in dress and home decoration had a definite correlation with automobile interior styling.

Aside from many hundreds of samples from mills, many more were received from outside styling consultants, division executives, other company employees, dealers, swatch houses, and European stylists.

The problem of selecting the most interesting styles from among 2,000 to 5,000 possibilities belonged generally to the head stylist of the company and his assistants. In some companies, the head stylist was assisted by the chief trim or fabric engineer, but in smaller companies the stylist assumed full responsibility.

The principal basis for selection and elimination at this point was appearance, i.e., the style of the fabric had to be consistent with what officials in the styling department thought was new and interesting, and what the contour and color of cars would be one and one-half to two years in the future. Price and general suitability (weight and construction), although considered, were not of paramount importance. Generally, if a fabric was suitable in appearance but too high in price, the company's fabric engineers substituted similar but lower cost fibers. An interesting drapery or dress fabric was not disqualified until the trimming department determined that the same style could not be produced in suitable weight and grade.

This first screening, which eliminated up to 90 percent of the swatches originally submitted, usually left approximately 75 to 200 pieces for further consideration, or about five or six fabrics for each model. The styling department had the primary responsibility for this initial selection.

It is important to note that the initial screening and selection was centered around the body cloth for the seats. Because seats predominate in the automobile interior, the styling and appearance of upholstery materials were given the most attention. Coordinate materials for sidewalls, headlining, and carpeting were selected at the same time as upholstery materials.

At this point, the styling department had firm convictions about the most desirable fabrics for the different priced cars made by the company.

Before the first style show, however, product planning personnel representing the company's various makes, lines, and models were asked to make a preliminary screening of the samples.

Product planning usually had the responsibility for determining the total budget for the automobile interior including maximum allowable cost of fabrics and fibers. However, styling and engineering had the authority to work out the type and cost of individual materials for the interior as long as the total cost did not exceed the budget.

## 2. First Style Show

A preliminary style show was generally held for each division of a company 15 months before automobile introduction. Top executives representing each car manufactured met with the head of the fabric and trim engineering department and with the chief stylist. Their purpose was to review the swatches which had successfully passed previous screenings. Many of these swatches were not of automotive weight, and, in some instances, only drawings of the designs were included. In one company, however, all the fabrics presented at the first show were tested for performance before the first style show.

At this stage, the principal interest was to establish the general direction for the final styling of the car interior. The basic scheme and colors were developed at this time. In addition, the styling, engineering, and product planning departments agreed on pleats and stitching that would fit in with material specifications and production problems. Most of the swatches were discarded because they were not in keeping with basic concepts of the general character of the car's interior. One company upholstered a few models in one color, to show design effects without the confusion of several colors in one interior. Color chips were available to indicate the alternative colors.

Although the price of a fabric was not a principal consideration at this meeting, division management could reject a fabric on this basis. The management of each specific car division knew about how much money could be allotted for trimming because this figure was the cost of trimming the previous year's model. Every attempt was made to keep within the same budget.

The first show was held a year or more before the car was scheduled to go into production because the mills had to have sufficient time to produce the fabrics. Another reason for the early scheduling was that, between the first and second style shows, both the mills and the companies needed to do a great deal of laboratory testing of fabrics.

## 3. Testing Fabrics' Suitability

After the first showing, all of the fabrics which were considered acceptable in appearance and price were tested for performance. The testing period lasted up to 140 days.

The styling department of some of the larger companies had tests made of swatches considered too expensive by management. If a swatch was particularly attractive and also performed well, cheaper fillers were substituted or threads were subtracted so that the price was reduced sufficiently to comply with budgetary restrictions. If, however, budget limitations could not be met but the styling department still had a strong liking for the appearance of the material, attempts were made to convince division management that the fabric's merits would outweigh the cost factor. Reports indicated that industry stylists had become increasingly successful in this respect in recent years. It was pointed out, however, that stylists generally made every effort to adhere to fixed budgetary considerations. Yet it was not uncommon that styles in fabrics had changed so markedly in a model that the fabric considered cost measurably less than the prior year's fabric.

Details of the various fabric tests employed by the automobile industry are presented in the section dealing with upholstery materials. Often these tests revealed that a particular fabric, though attractive, was unsuitable for trim purposes because of one weakness or another. The styling and trim departments might then make a special effort to obtain the desired characteristics without raising the cost. To do this, generally the cloth was taken back to the mill to determine whether desired characteristics could be achieved.

The mills played another important role in the selection process at this time. When a fabric not of automotive weight or construction was selected at the first style show, the mills were asked to bring it up to expected standards while maintaining appearance. Members of the automotive industry sometimes spent months in cooperative effort with the mills to achieve success in this respect.

Reports of test results on fabrics were received from the laboratories by styling and trim personnel. The various management groups of each car division were not directly informed of the success or failure of a particular piece of goods and generally had little to do with this phase of the operation. When management was asked to review the fabrics again for final decision, it was assumed that all samples submitted to them for inspection were suitable for use.

After all tests were completed, the remaining samples were collected, and preparations were started for the second style show.

#### 4. Second Style Show

The first step in preparing for this show was to have the mills supply a small bolt of each of the materials under consideration. With these materials, the interiors of several automobiles were trimmed as if for sale to give a realistic completed display. The show generally consisted of 3 or 4 upholstered cars and a display of the remaining fabrics. Generally, the reason offered for actually trimming cars with the fabrics was simply a desire to see the designs as they would look to the consumer. Such factors as the appearance of the material in a confined area and the possible change in appearance because of the lighting effects or shadows inside a car were also considered.

The second step of preparation occurred before the actual show, when product planning officials from each division were invited to review the selections which the styling department had readied for the second show. In accordance with suggestions offered by the division personnel, ideas were developed for selecting bolster cloths to go along with the body cloths, for determining where pleats should be located, and for deciding on other style and trim details.

When the second style show was completely arranged, the top division executives and various department heads were invited. Included in this group were officials such as division president, vice president, general manager, general sales manager, advertising manager, purchasing agent, product planning manager, and several others. At this point usually all questions of price and performance had been settled and appearance was the principal basis for judging.

Upon completion of the show there were generally 3 or 4 fabrics which had not been eliminated. The 3 or 4 cars upholstered in the fabric "candidates" were driven by a top executive for 2 or 3 weeks. After this test, the division management and stylists decided which of the fabrics to use.

Before plans were made final, the corporation president and other executives were always invited to look at the selections. The selections were usually approved by the corporation management. It was reported that rarely did a top executive so strongly dislike a fabric at this juncture that he insisted on its elimination.

## 5. Implementation of Selection

After final selection, the company's fabric engineers examined the fabric once again with an eye toward reducing its cost while maintaining its quality and appearance. (The actual price paid for a fabric was often below the figure originally approved.) The purchasing department was then informed of the final decision and started to work with the original suppliers. However, before production got under way, several models from the year before were trimmed to work out any "bugs" that might arise in the manufacturing. The suppliers worked along with the companies' technicians in an effort to reduce the cost of the goods to a minimum. The purchasing department tried to find at least two other mills capable of producing the same cloth at the same price. Comments indicated that three suppliers were standard; however, for an unusual cloth for a limited production model, one or two suppliers were satisfactory.

The mill submitting the original sample got the first and usually the largest order. The other mills were selected on the basis of their cooperation with the company and their ability to produce the desired cloth. Many of the executives placed emphasis on the fact that at least three sources were necessary for a large quantity of fabric. Sometimes in the past one supplier alone could not meet production schedules. Some companies placed orders 9 to 10 months before automobile introduction in order to be assured of supply.

The fabric selection process described above was representative of the larger companies in the automobile industry. For the most part, the same

procedure was also practiced by the smaller companies. Of course the largest companies' selection process could have involved 10 times as many people as that of the smaller concerns.

Perhaps the outstanding difference between the various sized companies was the matter of final selection. In the smaller companies, top management took a much more active part in selection of sample fabrics: usually, an executive committee consisting of the company vice president and one or two other top personnel worked closely with the chief stylist throughout the selection routine.

Another difference was that the smaller organizations tested their samples but did not go to extensive efforts to redesign materials to give them desired characteristics. In addition, if a fabric was too costly, these companies did not go to the same degree of redesigning to bring down the cost. These were the major differences between large and small companies.

It should be emphasized here that the selecting, testing, and matching process was a continual and repetitive evaluation of many samples until the final interior of any one model was a whole esthetic unit.

This description of the step-by-step procedure used in choosing trim materials deals largely with the selection of fabrics to be used for upholstery. Since the designs of the headlining and sidewall fabrics chosen were dependent to a great extent on the final choice made for upholstery, the selection procedure for these parts was considerably less formal than for upholstery fabric. Based on the final selection for upholstery, the styling and engineering departments cooperated in finding good complementary sidewall and headlining materials at suitable prices. The effects to be achieved in trimming the sidewalls were usually presented to division management for final approval in the form of artists' sketches.

The trim engineering department was responsible for the selection of padding and sheeting materials and consulted management only if the price of the materials selected was in excess of the levels set. The same held true for the engineers who were the sole judges of what was to be used for insulation purposes. In addition, trim engineering and the engineering department were responsible for developing techniques for bonding trim materials on side panels. These techniques influenced the types and characteristics of materials used.

Convertible tops were selected by engineering and styling groups. This was usually a relatively simple process. In the event of a change in materials, the selection was subject to approval of the division manager who placed particular emphasis on price and performance. By the 1961 model year the quality of convertible tops had been so well developed that the type of materials and the construction of the top was relatively fixed.

# MATERIALS EVALUATED FOR SELECTED PARTS

## Upholstery Materials

### Definition

Upholstery material, or body cloth, is the external covering for seat backs and seat cushions. Some parts of the upholstery material are also referred to as bolster cloth.

### Desirable characteristics

Thirty-eight executives were asked what characteristics they wanted in upholstery materials. When the characteristics reported as desirable for upholstery were weighted by production, they fell into three broad headings, with considerable difference in emphases. Performance considerations ranked very high, attractiveness factors ranked second, and properties related to ease of handling and tailoring in production ranked third (table 8).

Within the framework of these headings, specific characteristics mentioned were:

Performance over a period of normal use by the car owner .....58%

- a. wear resistance and durability
- b. color permanency
- c. seam and tear strength
- d. soil resistance and cleanability

Attractiveness to the customer .....28%

- a. soft hand, feel, rich looking
- b. cool feel

Ease of handling and tailoring in production .....14%

Executives were also asked to name the characteristics which, in their judgment, were in greatest need of improvement. When the group replies from the automobile companies were weighted by production, the three characteristics most needing improvement were color stability, soil resistance, and resistance to fraying (table 9).

In addition to characteristics deemed necessary by automobile executives for an ideal upholstery fabric, general factors of greatest influence in the actual selection of upholstery were determined by asking executives to rank in order of importance seven specific factors.

The average rank-order score for each factor is given below. A score of 1.00 means that all executives agreed in rating the factor thus scored as most important. A score of 7.00, on the other hand, means that all rated that

Table 8.--Characteristics wanted in upholstery materials

Characteristic	Total weighted replies 1/
	Percent
<u>Performance over a period of normal use by car owner</u> .....	<u>58</u>
Wear resistance, durability .....	7
Permanency of colors, resistance to aging and fading .....	7
Tear strength, resistance to tearing at seams ..	7
Soil resistance, cleanability .....	6
Elasticity .....	5
Porosity, breathability .....	5
Resistance to water spotting, moisture, etc. ....	3
Resistance to wrinkles .....	3
Slidability .....	3
Dimensional stability .....	2
Resistance to abrasion .....	2
No harsh finish, not hard on clothes .....	2
Sufficient moisture absorption for comfort .....	2
Low static charge through use of cotton or rayon; shockproof .....	2
Resistance to fogging (minimize fogging of windows) .....	2
<u>Attractiveness to the customer</u> .....	<u>28</u>
Soft hand, feel .....	6
Cool feel .....	6
Appearance, general .....	5
Cool in appearance .....	3
Expensive looking, elegant; three dimensional ..	2
Modern, contemporary styling .....	2
New, novel, flamboyant .....	2
Decorative .....	1
Iridescence .....	1
Nonshiny .....	*
<u>Ease of handling and tailoring in production</u> .....	<u>14</u>
Ease of handling, tailoring .....	6
Not susceptible to raveling or fraying, does not slow down production .....	5
Easily cut without slipping .....	2
Meet industry specifications, generally .....	1
Total .....	100
Number of companies responding .....	5

\*Less than 1 percent

1/ See page 3 for explanation of weighting procedures for this and subsequent tables.

Table 9.--Upholstery material characteristics which needed improvement most

Characteristic	Total weighted replies
	<u>Percent</u>
Permanency of color, increased resistance to moisture fading .....	15
Soil resistance, prevention of water spotting .....	14
Resistance to fraying, raveling .....	14
Resistance to bleeding and crocking .....	8
Resistance to matting of cotton .....	8
Three dimensional effects; false seams; simulation of decorative pleats .....	8
Moldability, forming qualities to minimize sewing and tailoring .....	6
Unitized surface fabric and padding assemblies .....	5
Flex resistance .....	5
Resistance to wrinkles .....	5
Resistance to needle heat, steam and other factors of production .....	5
Breathability of vinyl .....	2
Cleanability .....	1
Tear strength .....	1
Performance and attractiveness (general) .....	1
Resistance to absorption of heat and cold .....	1
Dimensional stability .....	1
Elimination of tight selvage of backing material, avoidance of puckering .....	*
Total	100
Number of companies responding	5

\*Less than 1 percent

factor as least important among the 7. In other words, the closer the average rank-order score is to 1.00 the greater was the importance of the factor in the judgment of the executives.

<u>Factors</u>	<u>Average rank-order</u>
Appearance -----	1.16
Cost -----	3.36
Performance -----	3.43
Ease of handling -----	4.21
Availability -----	4.56
Comfort -----	4.78
Prestige with customer -----	6.51
Number of executives making rating -----	38

Appearance was clearly the leading factor, confirming earlier evidence of the importance of styling in the selection of interior trim materials.

Most of the executives commented that the factors under study were so closely interrelated that it was difficult to assign ranks to each in realistic terms. It was also pointed out that some of the factors offered for ranking must be taken for granted in selecting materials. Thus, while cost was considered to be very important, it was stated that when appropriate appearance was available, the automobile company laboratories, working in conjunction with suppliers, could often bring final price in line with budgetary requirements by manipulating fiber combinations. However, any material not brought within allowable cost ranges was unlikely to be accepted. Similarly, availability was not considered a problem because suppliers were able to provide for the automobile industry's requirements.

In discussing these factors and the availability of materials, one executive commented that:

"Today we have a wide range of materials available to us. Ten years ago we would probably have paid higher prices than we did to get materials for our luxury class automobiles, because many of the most expensive fabrics then available, were not as interesting or attractive as the materials we can not put in our moderate- and lower-priced cars. This, in my opinion, is all due to the development and versatility of synthetics."

In connection with general subject of cost as a purchasing consideration, some executives asserted that occasionally vendor companies or their industry groups adopted nonproductive selling philosophies vis-a-vis the automobile industry. One executive stated in this regard:

"Some companies wishing to sell our industry are quite unrealistic in their approach to us. They may retain a well recognized individual as a kind of sales emissary who does not fully understand our industry needs in the hope that his reputation and importance will influence us."

"We have no objection to this approach but you must remember that we are a mass production industry, fighting costs every inch of the way. Anyone selling us must be fully aware of our problems as well as every aspect of his own product. A material, even if it happens to have superior characteristics of some sort, doesn't necessarily replace what we are already using, if it is more expensive than what we are using--not unless it really adds something tangible. In other words, we fight to conform to the budget ranges we have set up for various applications; and, if the material can't be modified to fit those ranges, we are unlikely to use it. Of course, this is not to say that we don't occasionally exceed our budget slightly, particularly in higher priced vehicles, for something really different.

"One other thing while on this subject. We won't go the reverse route either. Our laboratories have set up very rigid quality standards and we cannot accept materials below those standards, no matter how low the cost."

#### Measurement of characteristics for performance over a period of normal use, 1955 and 1961

In 1961, as in 1955, the automobile firms tested fabrics themselves to measure performance characteristics and suitability for specific uses. In both years, all of the companies employed laboratory tests of wear resistance, color permanence, soil resistance, stretch, and tensile strength. In addition, the companies tested for other attributes such as resistance to water spotting, bleeding, and fogging characteristics, when these were important for specific fabric applications. Several of the companies also observed performance under actual field conditions, said to be very valuable in evaluating such characteristics as slidability, coolness, cracking, fade resistance, comfort, and general suitability of fabrics. Company policies varied regarding the total amount of time and money to be spent on testing. Whereas one company might have checked every characteristic with great precision, another might have checked only the most important attributes in their own laboratories. However, all of the companies required that test samples of materials be submitted for approval. While sampling methods varied, all companies reserved the right to reject materials which did not measure up to prescribed performance. Some of the companies included defect allowances in their specifications.

#### Wear resistance

Essentially the test methods did not change between 1955 and 1961. Machines either pressed an abrasive substance (such as emery cloth or cotton duck) against the material and rotated one or the other, or they rubbed the abrasive back and forth across the fabric. These motions, generally referred to as revolutions or cycles, were sometimes combined. The duration of contact, coarseness of the abrasive, and degree of pressure were varied depending upon the fiber content and end use of the fabric being tested.

Although several mechanisms were reported for testing the wear resistance of automotive fabrics, each performed a similar function, that of abrading the material for a specified time and under a particular weight load, after which the fabric was examined visually for signs of excess wear. In general, woven fabrics were required to withstand the prescribed minimum abrasion with no thread breakage or discoloration whereas vinyls were expected not to show a loss of grain.

Although it is not feasible to list every test situation, some examples are given. In one test the revolutions to which vinyl coated body fabrics were subjected, depending upon the backing materials, ranged from 100 to 1,000 cycles in both warp and filling directions using a 240 grit abrasive whereas two other companies subjected all vinyls, regardless of backing materials to 50,000 double rubs of number 8 cotton duck. A fourth company stipulated that all vinyl coated materials used in seating assemblies shall be subjected to 1,000 cycles, at 1,000 grams, using CS #10 wheels. However, the minimum test for printed vinyls or those containing metallic yarns was 500 cycles. Woven body cloth standards also varied. One company, for example, stipulated that trim materials withstand a minimum of 300 cycles on the abraser using H 38 wheels and 500-gram weights whereas another required 500 cycles, using a #10 wheel at 500 grams and a third, 25,000 cycles dry using the test meter with number 8 cotton duck.

As illustrated above, standards and requirements varied from company to company; and suppliers, therefore, had to obtain individual specification sheets from the automobile concerns. In addition, test characteristics varied according to application in the car. For example, wear resistance requirements were less rigid for headlining than for seat trim material; more rigid for side-walls where scuff resistance is likely to be measured in addition to wear resistance.

Furthermore, some companies stressed that their stipulated test performance requirements were minimum and were variable for specific material types. Companies also were apt to make functional service tests for wear.

### Permanency of color

The same tests for color performance were used in 1955 and 1961. Executives reported that these consisted of placing fabric swatches under the light of the Florida sun or of a standard testing device in the laboratory, and then examining them to determine the degree of fade. In the laboratory test device, the swatch was exposed to an ultraviolet light for a specific time period under controlled temperature and humidity conditions. Woven fabrics were exposed for as few as 40 hours and vinyls for as many as 230 hours. Using the actual Florida sunlight, exposure times ranged from 25 to 100 hours. One company stipulated that sun tests take precedence over laboratory tests in its decisions on color stability.

These data, incidentally, were for all but the outer surfaces of convertible top materials, which were tested for longer periods. One automobile company reported, for example, that vinyl top surface materials were tested against fading for 1,000 hours.

Very slight changes were permitted after exposure to fade tests. In one company the standard was described as "slight fading," in another as "a change in brightness and/or saturation (and/or loss of grain in vinyls), but no change in hue."

As noted earlier in this section, one of the improvements suggested by automotive representatives was increased color stability. Test procedures in the realm of color stability did not appear to provide the manufacturers complete satisfaction. One industry representative stated, for example, "We have tried various types of fade tests without real success--there is a lot of personal judgment based on past experience which must be brought to play in this area."

### Tensile strength

All of the automobile companies tested fabrics for tensile strength in the warp and fill directions. Tensile strength tests measure the amount of pull it takes to break a fabric. (Some companies include measures of percentage elongation before breaking in their tensile strength tests.) In the case of knitted fabrics the tests were made in wale and coarse yarns. Equipment for tensile tests was described as having pulling clamps which exert a uniform speed of 12 inches per minute. In general the test was also described as a "grab method," although modifications of this method were employed. Wet tensile strength specifications were also stipulated by some of the companies such as immersing materials "in 70 degree Fahrenheit water until completely sodden," blotting and testing immediately, or "immersing in water at room temperature for 16 hours," shaking off until "practically drip dry" and testing "within 15 minutes after removing from water." Specific strength requirements were the same under wet and dry conditions. The requirements again varied with the specific fabrics and their intended application. Warp strength requirements for woven body cloths ranged between 90 and 375 pounds and for supported vinyls between 55 and 130 pounds. Fill tests ranged between 70 and 270 pounds for woven body cloths and between 50 and 120 pounds for woven-backed vinyls.

### Soil resistance - moisture resistance

Most companies tested a fabric's reaction to soil by applying dirt or grease smudges and then using a cleaning fluid to remove them. For a particular fabric to be considered satisfactory, the grease and dirt were required to come off easily without leaving stains. Some companies also measured degree of stain from cleaning fluids and vinyl reflectance loss after cleaning. In one company this loss was stipulated as 0 to 10 percent desired, 15 percent maximum.

Resistance to water spotting was tested by sprinkling distilled water on the fabric, letting it dry, and then checking visually for streaks, spots, and other changes in appearance.

## Stretch

The stretch and "set" characteristics of automotive fabrics were measured either by a laboratory stretching mechanism or by fitting fabrics into cars and judging these qualities with respect to actual contouring in position. There were various laboratory procedures. One, for example, consisted of attaching a 27 pound weight to a suspended 3 by 9 inch swatch for 10 minutes and then measuring the degree of elongation. The degree of set was determined by removing the weight and remeasuring the swatch.

Not all companies had defined the stretch and set characteristics of fabrics. One company stated that test methods for stretch and set "are now under investigation and will be released when sufficient information is available." It was pointed out that stretch and set depended upon the fiber content and the application of the fabric. Naturally, a particular year's standards of stretch cannot be applied to another year's materials if there are significant changes in fiber content or proportions. For the 1961 model year, one firm indicated general requirements for woven fabrics of 2.5 to 8 percent stretch in both the warp and fill for woven body cloths and 0 to 3 percent set. Set was also limited in terms of percent of stretch, in this case to no more than 40 percent of the stretch. Stretch and set figures for vinyls ranged from 1 percent to 18 percent in the warp, with the higher figures applying to knit back materials; lower figures to woven back materials. In general, the permissible set was 25 percent of the stretch. Fill specifications ranged from 4 to 30 percent with the same qualifications as to backing material and set.

## Shrinkage

Some manufacturers in 1961 tested upholstery fabrics for shrinkage under controlled conditions, and at least one was considering addition of such tests in the future. One examination consisted of submerging a sample swatch in water at 70 degrees Fahrenheit and then drying it in air of the same temperature at 65 percent relative humidity. Measurements were taken in this test at the end of 30 minutes and then once again when the material and the room were at equal humidity.

Permissible shrinkage was sometimes stipulated in a range such as 1 to 7 percent for woven fabrics. One company set a desired shrinkage of no more than 5 percent but permitted a 7 percent maximum stipulating that its "purchasing department shall at all times work with and advise suppliers that they are to work within..." the desired range. Permissible shrinkage values reported for vinyl were somewhat lower than those for woven fabrics, ranging from 1 percent to 3 percent.

## Other tests

Numerous other measurements were made on automotive fabrics to ascertain the amount of bleeding, cracking, coolness and porosity, slidability, snagging, bow, wicking, dimensional stability under heat, perspiration fade resistance, and resistance to aging and cold. In addition, vinyl-coated fabrics were widely tested to determine the strength of adhesion of their backings.

Although all of these additional tests were not universally employed, the various companies placed a great deal of stress on one or more of them.

### Styling preferences for upholstery materials

While performance characteristics of a given fabric were judged for the most part by objective technical tests, style and appearance of a fabric were judged essentially by personal taste. In that regard, executives were asked to express their opinions on trends in color, shade, pattern, design, and sheen. Industry preferences and expectations in these areas may be of assistance in anticipating the character of upholstery materials which will be in future demand. A wide variety of differing opinions were expressed on future trends in styling. Representatives of one company did not necessarily agree with those of another, nor was there complete agreement within companies. Further, many executives prefaced their remarks on this subject with the reminder that styling trends often depend upon the type of car and design philosophy applied to particular models. Certain automobiles, regardless of size, may be considered "sporty" with a consequent effect on style, color, and pattern of interior materials. Similarly, certain fabrics may be deemed more appropriate for compact cars; others, for standards.

### Trends in color

To obtain opinions on trends in color, the executive groups interviewed were asked:

"What do you believe customers want your upholstery to look like, what are (the) color trends?"

Analysis of replies on color trends indicated that neutral colors were expected to receive greatest stress, but that brighter interiors were expected to be of growing interest.

Executive groups within four out of five companies interviewed visualized a trend toward subdued, middle range, neutral colors. These opinions constituted 39 percent of the weighted replies on color trends. Representatives of the fifth company asserted that richer colors would come to the fore, but that they "would not be too bright." Despite the strong leaning to neutral, non-bright colors, many executives also visualized that there would be some movement away from neutral configurations such as trends toward brighter jewel tones (32 percent weighted), stronger colors (13 percent weighted), and brighter colors through use of metallic or contrasting yarns (13 percent weighted). No predictions were made that colors would become very much more subdued or dull (table 10).

It is of interest not only that the variations in trend predictions represented genuine differences in opinion, but that they were based upon contrasting plans for different vehicle types or even for different areas of the country. More expensive vehicles, for example, were said to require more neutral and subdued colors. With regard to area variations, one industry representative stated:

"The Southwest wants bright clear cars--the Northeast wants dark browns and grays."

Usage of certain materials was also found to have an effect on color. Polypropylene, for example, was cited by one company as a valuable blending fiber due to its comparatively low cost and high strength characteristics. Reportedly, however, the color characteristics of polypropylene were such that materials containing it were somewhat duller in coloration than they would have been if some other fiber had been used in the blend. 5/

Several executives also indicated that consumer color preferences move like a pendulum from extreme to neutral back to an extreme. Public taste was also described as very responsive to the influence of economic conditions. The automobile industry, for its part, depicted itself as being influenced to a marked degree by the fashion and home furnishings industry in the realm of color selection.

During the group discussions, numerous comments expressing these points of view were recorded, some of which are presented below.

The cyclical nature of color selection, sometimes linked with economic cycles, was advanced as the reason behind a trend to neutrals.

"Middle of the road is a cycle. Both our company and the public buy on a cycle.

"Back in 1955, 1956, and 1957 we had as light a car as could be made. With a turndown in economic conditions in 1958, colors were still bright, but less intense. Neutrals are coming in now for women's wear and furniture."

Essentially the same cyclical factor was also used to explain a growing interest in brighter colors.

"The peak of intense colors reached its height in 1955 and 1956 and then tapered off but is now coming back in blues, greens, beige, and turquoise."

Exterior colors were cited as an additional reason for anticipating heightened use of neutrals within cars.

"We like neutrals as they are easier to match to an exterior . . . . There is (also) a trend away from two tone cars back to one exterior-color cars. This trend is another reason neutrals are becoming stronger. They blend in with more external solid colors.

"In compacts we have eight or nine exterior colors and four or five interior colors. Thus we must use many neutrals ...."

---

5/ After fieldwork for this study was completed, a major chemical company announced the development of effective means of dyeing polypropylene.

Although fashion and home furnishings trends were cited in support of a trend toward neutral colors, most references to these nonautomotive influences were in support of anticipated increases in the use of brighter interiors.

"Colors follow house furnishings and clothing trends. The woman's influence is strong. We expect elegant, richer, modern looking fabrics which are 'homey' and more feminine. We expect the fabric manufacturers to add enough glamour to keep fabrics rich looking but not too bright. People buy a car for one year (in contrast to buying), a chair for ten years, and don't want anything too dull, or too gaudy (in their cars)."

"The public wants color even in towels. We watch furniture shows and high fashion shows."

Many statements on the subject of color trends implied that color trends were not always readily predictable because they were more open to immediate changes based on consumer demand than other design factors such as pattern or construction. As noted above, executives said that economic conditions may affect the public's choice of color in a given year. Other such conditions cited were "war tension" and the "English coronation during which advertising and sales promotion stressed rose red and coronation blue."

Because color trends were subject to current influences as well as to planned styling programs, it was important that piece goods suppliers be able to shift from one color to another fairly rapidly during the automobile production year. Warp and filling characteristics of woven fabrics were said to be designed with this problem in mind.

Table 10.--Expected trends in color for upholstery material

Expected trend	Total weighted replies
	<u>Percent</u>
More subdued colors, middle range colors, neutral colors .....	39
Brighter, more intense colors, more life, more jewel like colors .....	32
Stronger colors .....	13
Brighter through use of neutrals plus metallic or contrasting yarns .....	13
Richer colors but not too bright .....	3
Total .....	100
Number of companies responding .....	5

#### Trends in shade

Light shades were designated as the most likely, medium shades as next most likely, to be used in future trim fabrics. None of the replies suggested

a trend to dark colors. On a weighted basis, 18 percent of the responses indicated that no specific shades would predominate in the future but that contrasting shades within individual models would be used to create variety.

Table 11.--Expected trends in shade for upholstery material

Expected trend	Total weighted replies
	Percent
Light .....	45
Medium .....	37
Range from light to dark .....	18
Dark .....	---
Don't know .....	---
Total .....	100
Number of companies responding .....	5

Executives who expressed shade trends were asked to describe the factors which, in their opinion, accounted for these trends.

Among those who thought that light shades would be used more extensively, the primary reasons given were as follows: (1) public preference as expressed by fashion movements in women's wear and home furnishings, (2) trends in the general character of public temperament, and (3) coordination with automobile exterior colors. One response indicated that lighter shades would dominate in more expensive cars; medium shades, in all others.

Greater use of contrasting shades within individual models was also attributed to fashion trends and to the "contemporary" effects available from designs of this nature. Anticipated trends toward medium shades were generally attributed to cyclical behavior; i.e., the public grows tired of whatever has been dominant, moves on to something else. Most exponents of this theory asserted that medium shades would be on the rise for the next few years.

The following comments illustrate executive thinking on shade:

"We expect shades to range light to dark--to be richer, more subtle and subdued. Like color, they follow home furnishing and clothing trends.

"Shades are tied to economic conditions of the time--light in good times, dark in poor times. We try to catch the public's general mood. In good times the public doesn't want something dull, they want life--a little sparkle. Right now we are leaning to medium shades. We expect more use of mediums and lights.

"Light metallic prints have been improved and are less expensive for exteriors. They will receive greater use and this will lead to lighter matching interior shades."

Trends in pattern or design

Three-dimensional pleated effects and various types of striped patterns accounted for 35 percent of the weighted replies. One company predicted that in compact models the only stripes used would be subdued.

Small patterns, geometric and nongeometric, were 20 percent of the production-weighted replies. Plaid patterns were also said to be growing in importance despite the fact that some of these designs might be considered "quite odd."

Other expected trends included use of fore-and-aft patterns to minimize wrinkle effects, and sharp, strong patterns.

As with trends in color and shade, many officials indicated that they based their predictions on what they saw happening in other design-conscious industries. For example, one design executive, commenting on the trend in patterns, stated:

"We watch the garment industry very closely. They set the pace. In my opinion, incidentally, mills are not learned in this respect. We see a greater emphasis on three dimensional effects now which create very attractive blendings."

The principal reasons offered for the trend to small patterns anticipated by executives were that these designs fit the "total car image we are trying to create" and "are in keeping with style trends of the day." One of the design officials pointed out that the automotive industry is striving to make car interiors look as spacious as possible.

Table 12.--Expected trends in pattern for upholstery material

Expected trend	Total weighted replies
	Percent
Stripes, three-dimensional pleated effects ...:	35
Small patterns .....:	20
Plaids .....:	19
Fore-and-aft patterns .....:	13
Sharp, strong patterns .....:	13
Total .....:	100
Number of companies responding .....:	5

Trends in sheen

Trim fabrics with dull surfaces were expected to be used more extensively (60 percent of weighted replies). However, as with other design characteristics, there was not complete unanimity on this subject and other executives (24 percent) visualized a trend toward more sheen arising from increased use of metallic yarns (table 13).

Other predicted trends were toward fabrics somewhere in between lustrous and dull or toward fabrics with a soft and plush look.

Basically these findings are the reverse of the opinions expressed in 1955 when dull fabrics were not mentioned at all and when more lustrous materials were anticipated as the predominant trend.

The cyclical nature of style trends was in evidence during discussions about sheen. An executive with one of the largest manufacturers expressed his interest in dull surfaces this way:

"We expect more emphasis on dull fabrics. Frankly we think it is nothing more than part of a cycle. We need a change to satisfy public taste and it is time to use surfaces that are more dull."

In 1961, and in 1955, both those executives who looked for upholstery fabrics to have more sheen and those who thought such fabrics would have surfaces between lustrous and dull based their expectations on similar reasons. In general, these reasons reflected (1) acceptance of synthetics because of their wide range of luster, and (2) desire for more striking appearance, for showroom appeal, and for rich modern-looking materials.

Some of the statements on this topic in 1961 included:

"I would characterize the trend as to semidull fabrics. Metallics are being added to fabrics and vinyls to achieve these effects."

"Like other design characteristics, we are following home furnishing and clothing trends in our surface characteristics. Women's influence will be felt. The need for materials which are elegant, richer and modern looking will lead us into a little sheen without the use of a trade-marked metallic yarn. You could characterize this as some sheen, but semidull."

"Nylon is becoming more popular and this means more sheen. This brightens the interior."

Table 13.--Expected trends in sheen for upholstery material

Expected trend	Total weighted replies	
	Percent	
Dull .....	60	
More sheen and luster .....	24	
Soft and plush look .....	10	
In between lustrous and dull .....	5	
Bright without sheen .....	1	
Total .....	100	
Number of companies responding .....	5	

## Trends in fabric construction

The opinions advanced on variations in surface texture indicated a heightened interest, within the automobile industry, in novel materials which would differ both from plain flat-woven fabrics and also from pile fabrics. 6/ However, executives agreed that traditional pile fabrics would not see service in the automobile industry in the foreseeable future. Pile fabrics were characterized as "old-fashioned," passe, and not in harmony with current styles. As in 1955, poor comfort characteristics and lack of slidability were also mentioned as contributing to the continued nonuse of pile fabrics.

Executives in all five automotive companies agreed that flat-woven fabrics would continue to predominate. This prediction on a weighted basis accounted for 40 percent of the replies. That the industry expected a departure from a completely flat appearance, however, was evidenced by the strong trend expressed toward materials with an illusion of three dimensions (34 percent of the weighted replies). Also predicted were some use of actual three-dimensional puff pleats and some use of heavier textured materials (table 14).

Emphasis on textured appearance as an expected trend for upholstery material was attributed to developments in the home furnishings field. These developments, it was said, had showed that synthetic and plastic materials could be used to create effects not available to the automobile industry in 1955. Typical statements on effects sought in 1961 included:

"All of our materials will be in the flat category. Three dimensional effects are coming in now. These give a nice illusion of blends in colors. Pile is hot and old-fashioned and our engineering people tell us it has very poor slide characteristics."

"Piles are not popular because wool broadcloth just won't sell. It has no slide to it. We will be using more of a flat-woven material which will take on a three dimensional appearance. It will look like it is pleated but won't be."

"We are leaning away from loop pile, novelty yarns and fringes; tending toward richness of depth combined with smooth feel. We are, in other words, using combinations to give a look of richness and texture; creating a dimensional illusion."

"Styles in surface relate to women's clothes which have become more thin and sheer. We don't try to make something look deep--but this happens usually as the result of patterns which cause an illusion of depth."

---

6/ A pile fabric has a velvety covering on the surface, formed by an extra series of warp or filling yarns that stand out from the ground structure to which it has been added. Pile may be in the form of loops (terry cloth) or the loops may be cut and sheared and termed "cut pile."

Table 14.--Expected trends in fabric construction for upholstery material

Expected trend	Total weighted replies
	Percent
Flat woven .....	40
Flat woven, tridimensional effect .....	34
Tridimensional puffs .....	13
Heavy texture .....	13
Total .....	100
Number of companies responding .....	5

Preferences in upholstery materials when cost considerations were eliminated,  
1961

Cost considerations aside, nylons--either alone or blended with rayon--were the most preferred upholstery materials. Considerable preference was also shown for a new blend made up of acetate, polypropylene, nylon, rayon, and metallics. Although industry stylists found vinyl an extremely versatile material for trim purposes, they did not consider it the most desirable from the point of view of general attractiveness. Cotton-backed vinyl, the most heavily consumed upholstery fabric in 1961, was not mentioned as a preferred material when cost considerations were eliminated. Polypropylene, a new fabric, created the greatest interest in 1961 because of its remarkable strength in comparison to other synthetics and because of its unique styling possibilities (table 15).

Generally, similar reasons were advanced for each preference no matter which specific fabric was involved. The major ones were: good wearing qualities, versatility of styling and construction, beautiful appearance, soft hand, rich body, and retention of color, in that order. Officials were also influenced by color, design, and pattern flexibility. In addition, slidability, dyeing qualities, ease of tailoring, resistance to scuffing, fire retardance, and moisture resistance were mentioned.

Nylon was still highly regarded for its great versatility, as shown by the comments which follow:

"Nylon has great versatility--it has attractive appearance, good wear qualities, lasting colors, and good body, hand, and tailoring characteristics."

"Nylon is the most versatile fiber in taking colors. This is particularly important because the industry is trying to make meticulous refinements in the total color coordination of the exterior and interior of the car. ... Nylon also has superior strength and wear characteristics which greatly enhance the lasting quality of the upholstery."

"... nylon is widely used in upholstery because of its versatility...."

Executives interested in polypropylene had this to say:

"Polypropylene represents unique styling, color and surface effect possibilities. Also it possesses superior engineering characteristics, such as durability, color stability, and comfort. Perhaps its versatility could be further described in that multiple color and three dimensional construction effects can readily be achieved with polypropylene ..."

Some preferred fabrics were used in all price lines of the 1961 passenger automobiles. For example, nylon was used in the body cloth of virtually every price class of car, not only among standards but also among compacts. The significance of the use of nylon is that automotive companies have found consumers expect highest performance from materials used in the compact cars just as they do from materials used in standard-sized cars.

Table 15.--Preferred upholstery material, regardless of cost

Material	Total weighted replies
	<u>Percent</u>
Nylon warp - viscose fill .....	46
Nylon (predominantly) .....	24
Acetate, polypropylene, nylon, rayon, and metallics .....	24
Nylon (100 percent) .....	6
Total .....	100
Number of companies responding .....	5

#### Types of materials reported used for upholstery, 1961

Cotton-backed vinyl and nylon-rayon blends were basic components in the largest number of fabrics. Five of the 10 materials used contained nylon and rayon. These 5 fabrics were used by 4 of the automobile manufacturers. Although only 3 of these 10 materials used in 1961 were cotton-backed vinyl, this combination was used extensively by all 5 companies. At least two companies each used some metallic yarn, acetates, saran, leather, or cotton.

Table 16.--Materials reported purchased for use in upholstery

Fiber combination	Companies <u>1/</u>
	<u>Number</u>
Vinyl with cotton back .....	5
Nylon warp - viscose fill .....	4
Viscose, nylon, metallic yarn .....	3
Viscose, nylon, and acetate .....	2
Nylon, rayon, and saran .....	2
Nylon, rayon, and cotton .....	2
Leather .....	2
Woven plastic saran and foam vinyl .....	1
Pigmented polyvinyl chloride and cotton .....	1
Vinyl coated knit cotton fabric .....	1
Number of companies responding .....	5

1/ Column adds to more than total answering because some companies gave more than 1 answer.

Auto manufacturers used a considerably narrower range of fabric types for upholstery trim in 1961 than they did in 1955. At that time, 33 different fiber combinations were used whereas in 1961 only 10 basic material combinations were reported to be frequently used.

Vinyl with woven or knitted cotton backing accounted for the greatest quantity of material used in both 1955 and 1961. While nylon and rayon blends were the second most important materials used in both years, their consumption in total decreased in 1961 because of cost economies in the body cloth and greater use of vinyl as a substitute. Vinyls, polyesters, acetates, and metals were used in upholstery fabrics in 1955 and 1961.

#### Variation in use of upholstery materials according to price class of cars, 1955 and 1961 7/

Whenever feasible, information as to which specific fabrics were used in the various makes, lines, and models produced by each company was obtained.

Generally, the same basic fiber components (e.g., vinyl, nylon, cotton, and rayon) were in universal use regardless of price class, and the same variations noted in 1955 in the use of fabrics according to price class of car applied in 1961. As price class proceeded upward, the amount of expensive material used reportedly increased and the use of less costly fillers diminished.

Makes of cars considered in the high-price class generally contained the richest blends of nylon. For example, blends containing up to 52 percent of nylon were reported in this class. Use of luxury materials was essentially restricted to the high-priced models; leather, for example, was used only in

7/ See appendix page 80 for definition of "Price Class."

standard-sized models. Cotton-backed vinyl was generally restricted for use as bolster trim in the top-priced models.

Medium- and low-priced makes consumed the largest portion of the cotton-backed vinyl reported. Nylon also enjoyed relatively wide usage in the medium-priced, low-priced, and compact models; but less costly fillers predominated in the blends and mixtures used.

Thus, just as there was considerable overlapping in the selling price among lines within makes of various classes, there was also considerable overlapping in the types of upholstery fabrics used with no firm demarcation as to price of fabric.

To determine the reasons behind use of particular fabrics, executives were asked:

Why did you decide to use a fabric of this particular content rather than something else in the same price range?

In 1955 and 1961, performance and appearance were of paramount importance in the selection process. In 1961, the executives indicated that nylon had the best performance and appearance qualities; however, vinyl and rayon also had a good measure of these characteristics but were less expensive and therefore used. These fabrics also were well rated for their ability to meet engineering requirements with regard to durability and resilience (table 17).

Table 17.--Reasons for selecting certain upholstery materials rather than others in the same price range

Reason	Total weighted replies
	Percent
Meets engineering requirements better than other materials (performance test, durability) .....	16
Wearability and strength best for price .....	15
Superior resiliency, elasticity .....	13
Best appearance for price .....	9
Superior cleanability .....	9
Hand feels superior to other fabrics .....	9
Breathability superior to other fabrics .....	9
People like it more than other materials (consumers choice of vinyl option) .....	5
Better suited to budget limitations .....	5
Better structure .....	5
Meets styling requirements (color, hand, eye appeal) better than other materials .....	2
Superior durability and appearance .....	1
More suitable for price class of car .....	1
Better balance between softness and wearability .....	1
Total .....	100
Number of companies responding .....	5

The suitability of a fabric meant not only its appearance and performance but its cost because all of these factors were thoughtfully considered in making the selections. In explaining use of materials other than those preferred, nearly all the executives mentioned that rayon was usually blended with nylon to reduce costs.

Executives were asked:

Is there anything cheaper you could use in place of your most used fabric that would serve the same purpose?

"No," was the response received from 19 of the 29 executives answering this question. The executives stated that any attempt to compromise style and quality for cheaper materials would be a serious error in today's competitive market. However, the remaining 10 executives' remarks were typified by the following summary: "Polypropylene is the least expensive synthetic fiber offered to date and it has exceptional performance characteristics. The only remaining hindrance is its inability to take colors other than black." 8/

When a fabric was finally selected, it represented the best available in terms of style and performance for a minimum cost.

#### Price limitations on upholstery fabrics for compacts and standards, 1961

For upholstery used in compacts, \$1.76 per lineal yard was the lowest price paid by any manufacturer and \$3.50 was the highest. For standard-sized automobiles, the price ranged from \$2.25 to \$6.50 per lineal yard (table 18).

In 1961, the lowest prices reported in each range were paid for backed vinyls, blends utilizing little nylon, and other low-cost natural and synthetic fiber combinations. The highest prices represented purchases of the richer nylon blends and luxury materials such as leather. Considerable overlapping was found in the prices paid for upholstery fabrics for cars thought of as being in different price fields.

Table 18.--Highest and lowest prices paid for upholstery materials, by price class of car

Price class of car	Price paid per lineal yard	
	Lowest	Highest
	Dollars	Dollars
Compacts	\$1.76	\$3.50
Standards:		
Low-priced	2.25	3.50
Medium-priced	2.65	4.50
High-priced	3.44	6.50

8/ See footnote 5.

## Trends in fiber content of upholstery materials

All of the executives questioned anticipated there would be some changes in the fiber content of upholstery materials. The majority of production-weighted replies (49 percent) indicated that an increasing amount of synthetic materials would be used for upholstery trims in the future (table 19).

Table 19.--Expected trends in materials for upholstery

Expected trend	Total weighted replies	
	<u>Percent</u>	
<u>More synthetics</u> .....		<u>49</u>
More expanded vinyl .....	11	
More synthetics in general .....	7	
More polypropylene .....	6	
More molded seats in five years .....	5	
More vinyl .....	5	
More woven plastics .....	5	
More polyamide resin .....	5	
More cloth made from vinyl filaments .....	5	
More metallics .....	*	
More nylon .....	*	
<u>Less synthetics</u> .....		<u>14</u>
Less metallics .....	7	
Less saran .....	7	
Less cotton .....	7	
More wool .....	*	
No change in cotton backing .....	15	
More knit backing than twill .....	5	
Some nylon for backing .....	5	
Some cotton and rayon blends for backing ...	5	
Total .....	100	
Number of companies responding .....	5	

\*Less than 1 percent.

The replies pointed to greater use of vinyl, particularly expanded vinyl.

"People are accustomed to vinyl because it is more serviceable. It can be wiped clean with a damp cloth. As a matter of record the large consumption of vinyl has been primarily because the public has requested the vinyl option when ordering a new car. In other words, vinyl commands a premium with the public. We expect to use expanded vinyl in the near future because it is less costly and is more breathable."

Nylon, already being used extensively, was expected to remain relatively stable. Its principal use will continue to be in blends. Two automobile

manufacturers displayed a strong interest in the future use of polypropylene because of its low cost and durability.

"We expect to use more polypropylene. Polypropylene is a fiber of sound physical properties, along with good cost advantages. It has exceptional durability. However, it will be used primarily as a blend, because it is too harsh to the hand to be used 100 percent ..."

Less saran was expected to be used because it yellows and becomes brittle with time. Less cotton was expected to be used because of its "poor wear qualities." However, all five companies forecasted that the use of cotton backing for vinyl probably would not be changed. Some replies indicated possible future use of nylon or rayon as backing for vinyl.

As a long-term development, two companies visualized a trend toward molded seats made of what was described generally as polyurethane foam. The idea was advanced as a possibility for the distant future.

Table 20.--Reasons for expected trends in material for upholstery

Reason	Total weighted replies
	Percent
<u>Synthetics</u> .....	<u>81</u>
Better effects with three-dimensional patterns .....	12
Reduced cost of product, cheaper .....	12
Exceptional durability, long wear .....	12
More serviceable .....	8
People like it and buy this option .....	8
Cleanability, wipe clean with damp cloth .....	8
Vinyl is soft and pleasant, not clammy .....	8
Dimensional stability and strength .....	8
Because of exterior metallic paint .....	3
More reliable, a synthetic for every need .....	2
Cotton as backing: best backing, lowest price, best hand: characteristics, workability, easy to seam, strength ..	10
Molded seats: still 5 years away, saves costs of inner- springs and labor, different contour .....	9
Total .....	100
Number of companies responding .....	5

"It is possible that more molded seats will be used five years from now but probably not in the immediate future. Molded seats are very artistic and will more likely start in the high-priced cars first."

The reasons given for the trend toward more synthetics centered about three-dimensional effects, low costs, and durability (table 20). Cotton was

expected to remain the principal backing material for synthetics, largely because it is the lowest priced material for giving dimensional stability to vinyl.

"Cotton consumption will remain relatively stable because it is comparatively inexpensive and has good workability, strength, easy to steam, and dimensional stability."

Sidewall Materials

Definition

Sidewall material is the external covering for the sides of the automobile interior, including covering on door panels and posts, and fabric covering dashboards and arm rests.

Characteristics wanted

Thirty-eight executives were asked to describe as fully as possible the characteristics a sidewall material should have to make it ideal.

Executives seemed to give relatively equal emphasis to the various overall sidewall characteristics and to the specific details within the groupings. Weighted percentages of replies were not widely separated and tended to support this view (table 21).

The key properties named in connection with sidewalls were:

- 1. Performance over a period of normal use by the car owner -----38%
  - a. soil resistance
  - b. cleanability
  - c. wearability
- 2. Attractiveness to the customer -----29%
  - a. integrate with body cloth
  - b. wide variation of effects in color
- 3. Ease of handling and tailoring in production -----33%
  - a. good dielectric properties
  - b. cheaper and easier to bond
  - c. improved forming qualities

Good dielectric properties, ease and low cost of bonding, and forming qualities were primarily emphasized in executives' discussions of desirable production characteristics. The increased use of vinyl and plastic films seemed to have focused attention on desirable production characteristics peculiar to this material; namely, the ability to take vulcanizing when making pleats and good dielectric bonding properties.

Table 21.--Characteristics wanted in sidewall materials

Characteristic	Total weighted replies
	Percent
<u>Performance over a period of normal use by the car owner</u> .....	<u>38</u>
Soil resistance .....	6
Cleanability, wipe clean with damp cloth, better resale value .....	6
Wearability, wear resistance .....	6
Moisture resistance, rain stain resistance..	4
Less wearability than upholstery because no flexing and abrasion .....	4
Scuffing resistance .....	3
Lighter weight than upholstery (cost and forming) .....	3
Permanency of color .....	3
Rot resistance .....	2
Prefer to eliminate cotton back to save money .....	1
<u>Ease of handling and tailoring in production</u> ..	<u>33</u>
Good dielectric properties, easy to bond ...	7
Cheaper and easier to bond .....	6
Improved forming qualities (polyethylene) ..	6
Ease of handling, manufacture (general) ....	4
Punctureproof .....	3
Tensile strength without stretching .....	3
Compatible to vacuum forming .....	2
Dimensional stability .....	2
<u>Attractiveness to the customer</u> .....	<u>29</u>
Integrate (blend in or match) with body cloth .....	7
Multitone, wide variation of effects in color .....	6
Wide variation of effects in style and design .....	5
Good appearance (general) .....	3
No wrinkles .....	3
Three dimensional effect, elaborate contour, texture .....	3
Simulated fabric .....	2
Total .....	100
Number of companies responding .....	5

Attractiveness to the customer was discussed primarily in general terms, the most important specific characteristic being that the sidewall material must be integrated with the upholstery material.

Executives were also asked to name the characteristics considered desirable for sidewall materials, which, in their judgment, were in greatest need of improvement.

The specific production characteristics which were reportedly in greatest need of improvement were formability of vinyl, lower cost bonding, unitized bonding, and vacuum forming.

In addition to expressing their opinions about ideal sidewall characteristics, executives ranked six specific factors influencing their choices of sidewall materials.

Average rank order of factors reported as entering into decisions on materials to be used in sidewalls was:

<u>Factor</u>	<u>Average rank order</u>
Appearance -----	1.58
Cost -----	2.94
Performance -----	3.36
Ease of handling -----	3.81
Availability of supply -----	3.97
Prestige with customer -----	5.34
Number of executives making ratings -----	38

Preferences in sidewall materials when cost considerations were eliminated

Thirty-eight executives were asked to name the sidewall material now on the market which they preferred, regardless of price.

Table 22.--Preferred sidewall materials regardless of cost

<u>Materials</u>	<u>Total weighted replies</u>
	<u>Percent</u>
Vinyl with cotton knit backing .....	38
Vinyl with nonwoven backing .....	13
Vinyl with no backing .....	13
Body cloth material (nylon and rayon) .....	13
Simulated body cloth (vinyl) .....	13
Thermoplastic sheeting .....	6
Thermosetting sheeting .....	3
Vinyl or other material easily dielectrically bonded:	*
Slush molded or vacuum formed materials .....	*
Total .....	100
Number of companies responding .....	5

\*Less than 1 percent

Vinyl in various combinations, with and without backing, was the preferred material (table 22). Thirty-eight percent of the weighted replies favored vinyl coating with a cotton knit backing, 13 percent showed a desire for vinyl with a nonwoven back, 13 percent indicated a preference for a vinyl simulated body cloth, and the same percentage indicated a preference for unsupported vinyl. Another 13 percent preferred a body cloth of nylon blended with rayon.

Certain thermoplastic and thermosetting sheeting materials were preferred because (1) they offered good three-dimensional styling effects, and (2) they were easily formed.

The principal reasons given for the preference for vinyl were versatility in styling, good dielectric properties, wearability, and attractiveness to customer. Nylon and rayon body cloth was preferred because the manufacturers felt that use of fabric on the sidewalls similar to that in the upholstery would aid in coordination of the interior styling.

#### Variations in use of sidewall materials according to price class of car

In general, preferred sidewall materials were those actually used in all cars, regardless of price class.

Cotton-backed vinyl was the principal material used in the majority of companies for their compact and standard models (table 23). In each price class, at least one company used vinyl with no backing and vinyl with rayon backing. In addition to the materials listed in table 23, one company used vinyl covered burlap in its station wagons.

Table 23.--Materials reported purchased for use in  
sidewall by price class of car

Material	Compacts	Standards <sup>1/</sup>		
	<sup>1/</sup>	Low	Medium	High
		priced	priced	priced
	Number	Number	Number	Number
Vinyl with knitted cotton backing .....	4	3	3	3
Vinyl with no backing .....	2	1	1	1
Vinyl with rayon backing .....	1	1	1	1
Poly-lined paper .....	1	1	1	1
Wool .....	1	---	---	2
Number of companies responding .....	5	5	5	5

<sup>1/</sup> Column adds to more than total answering because some companies gave more than 1 answer.

#### Price limitations on sidewall materials for compacts and standards

In discussing the variations in sidewall costs according to price class of

car, many executives indicated that the trend was toward use of the same type of material in all price classes. As one executive explained it:

"We put vinyls of equal cost in both compact and high priced models ..."

Table 24.--Highest and lowest prices paid for sidewall materials by price class of car

Price class of car	Price paid per lineal yard	
	Lowest	Highest
	Dollars	Dollars
Compacts .....	\$0.70	\$1.64
Standards:		
Low-priced .....	.70	1.60
Medium-priced .....	.70	2.80
High-priced .....	1.00	2.55

Trends in fiber content of sidewall materials

Thirty percent of the weighted percentage of total replies indicated that plastics, synthetics, and supported vinyls were expected to be used to a greater degree in the future (table 25). Some predictions pointed toward more vacuum formed materials and more unsupported films such as polyethylene. Less than 1 percent of the total weighted replies indicated an increased use of cotton-backed vinyl. Lower cost and greater flexibility in production appeared to be the principal factors behind consideration of materials expected to be used in greater quantity. Twenty percent of the weighted replies indicated no change in the use of synthetics.

Perhaps the most interesting trend envisioned by automobile executives is future use of molded materials for sidewalls (42 percent of weighted replies). Molded materials were discussed primarily in connection with door panels. The major reasons advanced for the molded products were:

"Molded materials give increased flexibility in production and creating designs and textures."

However, many executives indicated that development of molded materials for sidewalls was long range.

"We see no change for the next two or three years in present sidewall materials used. Beyond this it is hard to anticipate, because a number of technical breakthroughs have to be made in molding and forming of panels. Perhaps the approach can be made with the use of copolymer vinyl and rubber or polyethylene with foam backing."

Table 25.--Expected trends in materials for sidewall

Expected trend	Total weighted replies
	Percent
<u>More use of plastics, synthetics, and supported vinyls</u> .....	<u>30</u>
Vacuum formed materials .....	9
Unsupported polyethylene, plastics and films .....	9
Polypropylene .....	6
Polyester .....	6
Vinyl with cotton backing .....	*
<u>No change in the use of plastics, synthetics and vinyl</u> .....	<u>20</u>
Polyester .....	6
Synthetics (general) .....	6
Plastics (general) .....	6
Cotton-backed vinyl .....	2
<u>More use of molded materials</u> .....	<u>42</u>
Polyethylene with foam back .....	9
Copolymer vinyl with rubber back .....	9
Molded polyethylene snap-in panel .....	6
Molded polypropylene snap-in panel .....	6
Simulated body cloth (vinyl) .....	6
Linear polyethylene .....	6
Unsupported molded vinyl .....	*
Some use of floor covering materials .....	<u>6</u>
More use of plastic impregnated paper .....	<u>2</u>
Total .....	100
Number of companies responding .....	5

\*Less than 1 percent

In addition to the above trend predictions, small percentages of the weighted replies suggested some use of floor covering on the sidewalls and greater use of plastic impregnated paper.

It would appear that trends toward other backing materials than cotton and toward molded sidewalls, using unsupported materials, may threaten future cotton consumption for sidewalls.

Headlining Materials

Definition

Headlining is the external material on the interior ceiling of the car. For this study, headlining also includes sun visor covering.

Characteristics wanted

Representatives of all five auto companies were asked to describe characteristics of ideal headlining material. Weighted responses, when percentaged, showed that "performance over a period of normal use by the car owner" accounted for well over half; "attractiveness to customer," for a fourth; and "ease of handling and tailoring in production," for less than a fourth (table 26).

Within the framework of these three classes, some specific characteristics mentioned were:

- 1. Performance over a period of normal use by the car owner -----56%
  - a. easily restored to original condition
  - b. cleanability
  - c. sound deadening, good acoustics
  - d. soil resistance
  - e. permanency of color
  - f. better strength characteristics
  
- 2. Attractiveness to the customer -----24%
  - a. fewer defects in cotton
  - b. bulkier cotton yarns
  
- 3. Ease of handling and tailoring in production -----20%

An executive's comment summed up these major concerns of the auto industry:

"We must be concerned with a number of factors which center around performance and appearance. The cars must be resalable, and this requires that the automobiles be clean and attractive after a period of normal use. The colors should have permanency. In addition, the headlining should be

Table 26.--Characteristics wanted in headlining materials

Characteristic	Total weighted replies
	Percent
<u>Performance over a period of normal use by the car owner</u> .....	<u>56</u>
Easily restored to original condition to enhance resale .....	9
Sound deadening, good accoustics .....	6
Cleanability, general .....	6
Cleanability, cotton .....	5
Soil resistance, general .....	5
Soil resistance, cotton .....	5
Permanency of color, nonfading .....	5
Better strength characteristics .....	5
Resistance to tear .....	4
Moisture resistance, resist water stain .....	3
Dimensional stability .....	3
Nonfraying .....	*
<u>Attractiveness to the customer</u> .....	<u>24</u>
Fewer defects in cotton (misweaves, pulled yarns, slub yarns) .....	5
Bulkier cotton yarns .....	5
Good appearance, texture .....	4
Integrate with bodycloth, color .....	4
Crisper and more permanent appearance .....	3
Color latitude .....	3
Greater texture range to match upholstery ..	*
<u>Ease of handling and tailoring in production</u> ..	<u>20</u>
Snap-in headlining, one operation installation .....	5
Prefabricated, molded or utilized one piece material .....	4
Ease of handling or installation, tailorability .....	4
Shrinkability .....	3
Pliability .....	3
Lower installation cost .....	1
Lower replacement cost .....	*
Total .....	100
Number of companies responding .....	5

\*Less than 1 percent

durable as well as offer good sound-deadening characteristics."

As with other parts of the automobiles, executives ranked six major factors entering into their selection of headlining materials. Average rank order of these factors was:

<u>Factor</u>	<u>Average rank order</u>
Performance -----	1.34
Appearance -----	2.56
Cost -----	2.86
Ease of handling -----	3.84
Availability of supply -----	4.91
Prestige with customer -----	5.52
Number of executives making ratings -----	38

#### Preferences in headlining materials when cost considerations were eliminated

Executives were asked to name the available headlining materials which most nearly met requirements for appearance and performance, ignoring the cost factor.

Table 27.--Preferred headlining materials regardless of cost

<u>Material</u>	<u>Total weighted replies</u>
	<u>Percent</u>
Vinyl-coated fabrics (backing unspecified) ..	27
Vinyl-coated cotton, cotton backed .....	26
Cotton .....	18
Urethane .....	18
Vinyl, perforated, cotton backed .....	7
Glass fiber .....	4
Total .....	100
Number of companies responding .....	5

Vinyl-coated fabrics, including vinyl-coated cotton, and perforated vinyl with cotton backing were the preferred materials; they accounted for 60 percent of the weighted replies. Some comments about vinyl headlinings were:

"We use vinyl in our headlining because it gives a crisper, more permanent appearance to the car interior."

"Perforated vinyl has good insulation qualities: for it will subdue sound and vibration coming from the car roof as well as interior sound."

"It (vinyl) is cleanable, soil resistant, stylable, durable, and easy to fabricate. ... the cotton backing gives vinyl dimensional stability ...."

Cotton and urethane were each indicated by 18 percent of the weighted replies. Glass fiber, mentioned by one company, accounted for 4 percent.

#### Variations in use of headlining materials according to price class of car

Cotton with vinyl was the most popular headlining material (table 28). Five companies used it in compacts; four companies used it in low- and medium-priced standards and three companies used it in high-priced standards. Two companies indicated use of cotton in compact, low- and medium-priced standards; one company used cotton in its high-priced line. Vinyl (unsupported) was reportedly used by one company in all price ranges of standard-sized cars.

Table 28.--Materials reported purchased for use in headlining by price class of car

Material	:	Compacts	:	Standards <sup>1/</sup>		
				Low	Medium	High
				priced	priced	priced
		<u>Number</u>		<u>Number</u>	<u>Number</u>	<u>Number</u>
Cotton with vinyl .....	:	5	:	4	4	3
Cotton .....	:	2	:	2	2	1
Vinyl (unsupported) .....	:	---	:	1	1	1
Glass fiber .....	:	1	:	---	---	---
Number of companies responding ..	:	5	:	4	4	3

<sup>1/</sup> Column adds to more than total answering because some companies gave more than 1 answer.

It must be borne in mind that respondents reported only those materials most frequently or very widely used. Poundage figures presented in Part I of this report include these as well as other materials used for headlinings.

#### Price limitations on headlining materials for compacts and standards

The price paid per lineal yard for headlining materials used in 1961 showed a narrow range between lowest and highest prices paid for a class of car and between classes (table 29). The main reason for such small price differentials was that similar headlinings were used throughout all price classes.

#### Trends in types of headlining materials

When weighted by production, 47 percent of the replies about expected trends in headlining materials forecasted more use of preassembled units. Three

companies predicted a long range trend toward molded snap-in sections made of glass fiber or cardboard. Two companies predicted use of molded urethane on paperboard (table 30).

Table 29.--Highest and lowest prices paid for headlining materials by price class of car

Price class of car	Price paid per lineal yard	
	Lowest	Highest
	<u>Dollars</u>	<u>Dollars</u>
Compacts .....	\$0.67	\$1.10
Standards:		
Low-priced .....	.70	1.00
Medium-priced .....	.82	1.10
High-priced .....	.83	1.20

Although interested in preassembled units, officials pointed out a number of problems:

"Molded snap-ins are still not competitive in price. The cost of producing molded or formed sections is too high when you consider how difficult it is to fit the car roof which varies in size within any one model."

"One major problem with preformed headlinings is that they are quite difficult and costly to install. As an example, the windshield must be left off during processing which adds to the cost and time of production. Essentially none of the manufacturers have mastered the technique of inexpensively producing and installing headlining."

One company expected cotton-backed vinyl to be used in greater quantity because of its reasonable cost, ease of cleaning and stylability. More perforated vinyl was expected to be used because vinyl lends itself to unique styling effects and has good sound absorption qualities.

Twenty-six percent of the weighted replies indicated no measurable expected change in headlining materials.

Some executives forecasted decreased use of woven paper, cotton, and cotton backing. Specific comments were made about each of these products.

"Woven paper was used in the past in station wagons. It was a lower cost material. However, it was tough to fabricate, so we have ruled it out."

"Cotton developed a number of complaints in 1961 because it stained easily and was not readily cleanable. Therefore,

we expect to decrease our use of it because this performance limitation inhibits used car sales."

"Cotton backing will be reduced through weight reduction. In other words we were using 6 to 7 ounce cotton, but we intend to decrease the backing to 5 or 6 ounce cotton. This will not jeopardize the strength but will save us money."

Table 30.--Expected trends in materials for headlining

Expected trend	Total weighted replies
	<u>Percent</u>
More use of:	
Molded snap-in sections (glass fiber or cardboard), long range trend .....	10
Urethane, molded on paperboard .....	7
Hardboard .....	12
Snap-in glass fiber .....	6
Unitized assemblies .....	6
Embossed (textured) vinyl .....	6
Cotton-backed vinyl .....	6
Perforated vinyl .....	2
No change .....	26
Less use of:	
Woven paper .....	9
Cotton .....	8
Cotton backing .....	2
Total .....	100
Number of companies responding .....	5

### Seat Cushion and Back Padding

#### Definition

The padding used in seat cushions and backs is composed of a number of individual parts. The parts are often made of different types of materials. Two or more pads are placed over the coil springs. The "spring" or "base" pad, immediately above the springs, is usually made of low grade cotton or of a mixture of cotton with jute or sisal, or of 100 percent jute or sisal. A top-per pad is placed over the spring pad. This is generally made from good quality cotton linters, pickers and fly, or of 1-3/4 inch to 2 inch thick foam rubber.

Some auto companies make their own seat pads but, in many instances, pre-formed pads, encased in sheeting, are received from suppliers. Usually these pads are shaped and ready for assembly in the car.

### Characteristics wanted

Executives were asked to describe the characteristics required in ideal padding materials. Resiliency, the ability of padding to retain its shape, was mentioned by all companies (26 percent of the weighted replies), and was the most important single factor for good padding (table 31). Ability of a pad to absorb as little moisture as possible and not to deteriorate when moisture is absorbed was the second most important feature (22 percent weighted). Other important features sought by the executives were: comfort, 12 percent of weighted replies; appearance and odorlessness, 11 percent each; and ease of handling, 8 percent.

Table 31.--Characteristic wanted in seat padding materials

Characteristic	Total weighted replies
	<u>Percent</u>
Resiliency: returns to original shape so that upholstery fabrics do not sag or wrinkle. Does not pack down. Doesn't push through springs .....	26
Minimum of moisture absorption: able to absorb small quantities of moisture without deteriorating or becoming soggy .....	22
Comfort: smooth, completely free from lumps and wrinkles, soft but firm with good dampening qualities. Not too bouncy, good compression characteristics .....	12
Good appearance: should look comfortable, have a firm, billowy, or plushy appearance .....	11
Odorlessness: should not have or pick up objectionable odors .....	11
Ease of handling: should not tear in handling, easy to trim and shape .....	8
Minimum oil content .....	8
Fireproof .....	2
Coolness: should dissipate body heat, not get warm, should breathe well, be porous .....	*
Total .....	100
Number of companies responding .....	5

\*Less than 1 percent.

### Preferences in seat padding materials when cost considerations were eliminated

When price was not a factor, the auto executive generally preferred foam rubber. This material was favored because of its resiliency, superior comfort, ease of handling, high prestige, and uniform quality. In addition, foam rubber was considered to be the longest lasting padding material with these favorable

qualities. Cotton, preferred when price was not a factor, was used for the bulk of the padding in the seat cushions and pads. However, many topper pads were of urethane or rubber depending on the price of the car.

#### Variations in use of seat padding materials according to price class of car

In 1961, urethane topper pads were used for padding cars of all price lines. This was true for both cushions and seat backs. It should be noted that, in the earlier (1955) report, urethane had not come into use, and foam rubber reportedly was the material which the customers "frequently special ordered" because of its superior quality. However, in 1961 urethane had been developed to a point where it reportedly equaled foam rubber in most respects and was also much cheaper. Therefore, in 1961, executives said foam rubber was used only in the higher priced cars where it might be considered more of a prestige material. One luxury compact also used some foam rubber. Because cotton was a low-cost material, it was used in all price classes of cars, although foam rubber or urethane may have been considered to have better performance characteristics.

#### Price limitations on seat padding materials for compacts and standards

Executives were asked to discuss the prices they would pay for seat padding for compact, low-, medium-, and high-priced models. Specific figures are not published because the high end of the range would involve disclosure of company identity although the low figure for compacts, low-priced standards, and medium-priced standards started at approximately \$3.00 per pair of pads.

#### Trends in types of seat padding

Executives of all five companies forecasted that more polyurethane would be used in the future (32 percent of weighted replies). In addition, 28 percent of the weighted replies suggested that the use of foams and synthetics would trend toward molded seats. Twenty-five percent of the weighted responses indicated a trend toward greater use of synthetic pads (table 32).

Although none of the executives specifically forecasted less use of cotton, the implication was that consumption of both cotton and rubber would decline. Lower cost urethane was predicted to replace them because it has superior resiliency to cotton and can be easily formed and molded to the precise contour needed.

Several comments indicated the basis for predicting greater use of urethane:

"The chemical developments in polyurethane foams have been rapid and this product has improved significantly in its molding characteristics. In the next few years we will be molding polyurethane for most cars, if not all of them. In fact, the seats might be molded as a slab on the floor."

"We will be using a great deal more urethane in the future because it is among the cheapest padding materials and is readily molded."

"Urethane is as stable as foam rubber and it has passed all of our engineering tests."

Table 32.--Expected trends in types of seat padding

Expected trend	:	Total weighted replies
		<u>Percent</u>
More polyurethane .....	:	32
Molded seats .....	:	28
More synthetic pads .....	:	25
Less latex .....	:	15
Total .....	:	100
Number of companies responding .....	:	5

### Foundation Sheeting

#### Definition

Foundation sheeting is the cloth between the upholstery and the seat padding. It is used when necessary to hold the padding in place. In addition to this general purpose, sheeting is also used to back pleats, to stiffen foam rubber, and to attach upholstery to the frame. Preformed padding comes already contained in tobacco cloth sheeting.

#### Characteristics wanted

All of the executive groups with whom foundation sheeting was discussed placed emphasis on tensile strength and on resistance to stretch (table 33). Their interest was to insure against shifting of padding which can cause the seats to become lumpy. Ease of handling was of somewhat less concern because increasing amounts of padding, already encased in sheeting, were being purchased and used.

#### Variations in use of sheeting materials

Although the majority of manufacturers relied on tobacco cloth containers (for preformed pads) for their sheeting, all companies purchased some additional sheeting to reinforce pleats and seams. No detailed cost figures were available by price class of car but, generally, sheeting varied from 15 to 34 cents per lineal yard. Foundation sheeting varied more with application than with price class of car. Heavier sheeting was generally used as a foundation for

the fronts of seat backs, to back pleated upholstery, and to reinforce seams and foam rubber.

Table 33.--Characteristic wanted in sheeting materials

Characteristic	Total weighted replies
	<u>Percent</u>
Tensile strength:	
Strong and durable enough to contain padding without breaking under constant flexing condition, especially in seams and pleats .....	29
Resistance to stretch:	
Should not stretch nor allow padding to separate and become lumpy .....	29
Ease of handling:	
Easy to sew and handle, nonrevealing, purchase padding encased in sheeting..	23
Porosity:	
Fabric should breathe .....	13
Low cost .....	4
Dimensional stability .....	2
Total .....	100
Number of companies responding .....	5

Although sometimes used to reinforce foam rubber, foundation sheeting was not generally used over foam rubber seat cushions. Some executives reported using coarse sheeting or jute between the padding and springs or to hold the edges of the upholstery to the frame.

The lighter tobacco cloth was used to hold cotton pads in place on the backs of seat backs and on the front and rear seat cushions.

#### Trends in fiber content of sheeting materials

Ninety-three percent of the sheeting purchased for the 1961 model year was cotton, and auto executives indicated that cotton would remain the dominant sheeting material in the foreseeable future. Cotton was considered adequate by most companies. Manufacturers were satisfied with cotton because they felt it was sufficiently strong for this application, and because of its low price. However, some manufacturers indicated that cotton and rayon blends, or jute, or synthetics might be used to some extent in the future to prevent seat pad shifting. The increased use of foam rubber seat pads and molded urethane seat cushions may decrease the amount of sheeting used in the future.

## Thermal and Sound Insulation

### Description

Insulating materials are used principally under the roof, on the floor, on the underbody, on the door panels, behind the cowl, and sometimes under the hood and around the exhaust manifold. The insulation used in automobiles is designed to protect passengers from heat and cold, and from excessive noise produced by vibration of the engine or by movement of the car over the highway.

### Characteristics wanted

Executives were asked to describe what characteristics a thermal and sound insulation material should have to make it ideal.

The most important characteristics were fire resistance, thermal efficiency, and ease of handling (table 34). A new feature was introduced into the "ease of handling" category. Manufacturers expressed concern that the materials be free from dust or particles which might injure the workers.

Other important features were proper weight, rot resistance, moisture resistance, and "combined sound and thermal qualities." Executives went into detail in explaining that a number of factors were important for different situations:

"Each media must have the proper weight or density to insure that it will do the best job for a specific application. For example, mastic might be best for vibration, whereas fiberglass would offer the best protection in the firewall."

"What we really need are combined thermal and sound qualities. The insulation should have deadening properties, fire resistant qualities and most importantly it must be a good absorber of sound."

"Insulation should be bacteria resistant and should not allow the formation of mildew."

"Insulation should have stability so that it won't settle (mat) down and therefore lose its thermal efficiency."

### Preferences in insulation materials when cost considerations were eliminated

Glass fiber was strongly preferred for both sound and thermal insulation (table 35). However, its sound insulation properties were slightly less widely accepted than its thermal insulation properties. Asphalt-impregnated felt was reported to be the second most important insulation material, regardless of cost, with 30 percent of the weighted replies for thermal and 28 percent for sound qualities. A garnetted cotton-rayon material was the next in importance.

Table 34.--Characteristics wanted in materials for insulation

Characteristic	Total weighted replies
	Percent
Fire resistance particularly between the floor board and engine and on the hood .....	14
High thermal efficiency. Low K factor results from low density and therefore reduced heat losses .....	13
Ease of handling. Easy to cut and put into place without injury to worker .....	13
Proper weight. Correct density to give a balance of thermal and sound qualities .....	8
Rot resistance. No deterioration of insulation ..	7
Moisture resistance. Moisture collection will impair insulation value .....	7
Combined sound and thermal qualities. Minimize heat transfer and absorb vibration .....	7
Bacteria resistance. No mildew formation .....	7
Stability. Remain in place and not compress .....	6
Deadening properties. Absorb vibration .....	5
Sound absorption. Prevent sound transmission .....	5
Snap-in insulation sections .....	5
Porosity. Cellular structure reduces transmission:	3
Total .....	100
Number of companies responding .....	5

Executives were asked why they preferred a particular material for insulation. With respect to glass fiber, the majority stated that it was the best insulator against sound and heat currently on the market. Some of the specific qualities were cited as: "high efficiency as a nonconductor of heat," "non-flammable," "good sound absorber and reduced sound transmission," and "it resists moisture, rot, bacteria, and mildew."

Officials also reported that asphalt was the best material to reduce vibration. Car manufacturers also pointed out that addition of felt to asphalt made excellent sound and thermal insulation.

All of these materials were reportedly easy to handle and apply; this was considered an important feature. There was some evidence that the industry was primarily concerned with sound insulation:

"Sound and thermal qualities are both important; however, sound is the most critical problem to handle. The insulation requirement usually results from a sound or vibration condition. Once we solve this problem, the thermal characteristics of the sound insulation (material) more than take care of the heat transfer problems."

Table 35.--Preferred insulation materials regardless of cost

Material	Thermal insulation	Sound insulation
	Total	Total
	weighted replies	weighted replies
	Percent	Percent
100 percent spun glass with resin binder .....	53	50
Asphalt impregnated felt .....	30	28
Garnetted cotton-rayon .....	17	16
Random rag and wood fiber .....	---	6
Total .....	100	100
Number of companies responding .....	5	5

#### Variations in use of insulation materials according to price class of car

The overall use of insulation in 1961 varied widely. A number of different products were used in each part of the car, depending upon make, line, and model of car. As an example, eight materials were used in the roofs of automobiles.

As executives pointed out, there are many alternative situations:

"There are many places in the car where insulation is necessary--roof, doors, hood, and floor. Each of these areas has different problems to be handled in terms of sound, vibration, and temperature differentials. In addition, each automobile design causes these problems to vary in severity. As an answer to these needs there usually is more than one material that will satisfy the requirements."

Table 36.--Materials reported purchased for use in roof insulation

Material	Total weighted replies
	Percent
Asphalt .....	32
Glass fiber .....	16
Felt .....	13
Cotton .....	13
Synthetics .....	13
Wood fiber .....	5
Felt and dry paper .....	5
Paper .....	3
Total .....	100
Number of companies responding .....	5

Roof insulation: Roof insulation is primarily used to deaden sound caused by vibrations of the metal roof. Secondly, roof insulation serves to give protection from heat and cold.

Besides asphalt, roof insulation materials used were glass fiber materials, felt, cotton, synthetics, wood fiber, felt and dry paper, and paper (table 36). In general, glass fiber was used in the higher-priced cars while felt, cotton, wood fiber or paper were used in lower-priced cars.

Floor insulation: Floor insulation is used to keep heat from the exhaust pipe out of the car interior and to muffle road noise. The basic materials reported for floor insulation were asphalt, paper, felt, cotton, synthetics, and glass fiber materials (table 37).

Table 37.--Materials reported purchased for use in floor insulation

Material	Total weighted replies
	Percent
Asphalt .....	38
Paper .....	14
Felt .....	12
Cotton .....	12
Synthetics .....	12
Glass fiber .....	12
Total .....	100
Number of companies responding .....	5

Dash panel and cowl insulation: The primary purpose of this insulation is to protect the riders from engine heat. A secondary purpose is to deaden the sound of the engine. Glass fiber material was reportedly used in most cars, with mastic and felt ranking second and third respectively (table 38). Materials made of several layers of different insulators were reportedly in widespread use.

Table 38.--Materials reported purchased for use in dash panel and cowl insulation

Material	Total weighted replies
	Percent
Glass fiber .....	29
Mastic .....	25
Felt .....	13
Paper .....	9
Cotton .....	9
Synthetics .....	9
Asphalt .....	4
Jute, thread and resin .....	2
Total .....	100
Number of companies responding .....	5

Door panel insulation: Door panels were insulated against sound and vibration from road and tires. Asphalt was the principal insulator used in this application (table 39). However, other materials were used in 1961. Among them were cotton, synthetics, felt, and paper.

Table 39.--Materials reported purchased for use in door panel insulation

Material	Total weighted replies
	<u>Percent</u>
Asphalt .....	46
Cotton .....	19
Synthetics .....	19
Felt .....	8
Paper .....	8
Total .....	100
Number of companies responding .....	2/3

2/ Door panel insulation was not discussed with 2 companies

Hood insulation: Insulation was used under the hood primarily to deaden engine noise. Glass fiber was the principal material used, with asphalt ranking second (table 40). Asphalt served two purposes: bonding the glass fiber material to the hood and deadening hood vibration.

Table 40.--Materials reported purchased for use in hood insulation

Material	Total weighted replies
	<u>Percent</u>
Glass fiber .....	68
Asphalt .....	32
Total .....	100
Number of companies responding .....	5

#### Price limitations on insulation materials

Some information was collected on prices considered acceptable for insulation materials. Indications were that the per car range of such prices was between \$3.32 for high-priced cars and \$.13 for low-priced cars. These low-priced models had virtually no luxury appointments and, therefore, used only a bare minimum of insulation.

## Convertible Tops

### Description

Convertible tops are generally made in sandwich form by bonding a surface fabric to one or more interior layers. The exterior fabric may have a vinyl coating.

### Characteristics wanted

Performance during use by the car owner was considered by far the most important general criterion for a good top, according to the production-weighted replies (table 41). Second in importance was ease of handling and tailoring in production. Attractiveness to the customer at time of purchase received least emphasis.

Specific responses were obtained under these three broad headings:

1. Performance over a period of normal use by the car owner -----68%
  - a. color permanency
  - b. stretch resistance
  - c. durability
  - d. good folding qualities
  - e. waterproofness
2. Ease of handling and tailoring in production -----23%
  - a. flexibility
  - b. good sewing characteristics
3. Attractiveness to the customer ----- 9%

In addition to expressing their ideas and opinions as to ideal characteristics, executives ranked six factors which entered into decisions on convertible tops.

The average rank order of these factors was:

<u>Factor</u>	<u>Average rank order</u>
Performance -----	1.10
Appearance -----	2.14
Ease of handling -----	3.30
Cost -----	4.00
Availability of supply -----	5.04
Prestige with customer -----	5.41
Number of executives making ratings -----	38

Table 41.--Characteristics wanted in convertible top materials

Characteristic	Total weighted replies
	<u>Percent</u>
<u>Performance over a period of normal use by</u> <u>the car owner</u> .....	<u>68</u>
Color permanency, nonfading .....	9
Proper dimensional stability (stretch resistance, freedom from ballooning and wrinkling) .....	9
Durability--long life, resistance to weather: sun, mildew .....	9
Good folding qualities--folding without getting ragged or cracking .....	9
Resistance to cracking and leaking (waterproof) .....	9
Minimum shrinkage .....	6
Cleanability .....	4
Soil resistant .....	4
Resistance to water spotting, staining, wicking .....	4
Resistance to scuffing and tearing and abrasion .....	3
Seam strength .....	1
Resistance to rot, vermin-proof .....	1
<u>Ease of handling and tailoring in production</u> ..	<u>23</u>
Flexibility for production tailoring-- (workability, pliability, stretchability) :	8
Sew well .....	8
Good dielectric bonding characteristics ....:	4
Resist deformation to creasing .....	3
<u>Attractiveness to the customer</u> .....	<u>2</u>
Can be made in a wide variety of colors-- to match the rest of the car .....	3
Appearance of a woven fabric .....	3
Less sheen .....	3
Total .....	100
Number of companies responding .....	5

## Characteristics most in need of improvement

In general, a considerable degree of satisfaction was expressed with top materials in use in 1961:

"Historically this material necessitated careful engineering because of the critical nature of the application under extreme environmental conditions. The present 4 ply assembly of vinyl, fabric, butyl rubber and treated inner lining has been used successfully for the past six years. Therefore, any substitutions for this material will require thorough investigation."

"The material we are now using is the best material available and is used by most of our competition. It is easiest to work with. We can get it on the car wrinkle free."

There were also several suggested improvements. Among these were: easier to handle and tailor (general), greater resistance against wicking and moisture absorption (cotton), less sheen (vinyl), improved condensation properties more applicable to top interiors (vinyl). Other suggestions included:

"Improve the shrinkage characteristics of finished materials, warpwise, to .05 percent, improve the disappearance feature of wrinkles and creases of finished materials after the top has been folded and creased, so that wrinkles disappear almost immediately after the top is raised and under normal tension."

"What we would like in the future would be 'improved bonding and soil resistant properties and possible forming characteristics'."

"Eliminate the wicking qualities of inside lining fabrics, improve the dielectric qualities of finished materials, improve the natural sealing features of finished materials at needle holes when sewn through and improve the cleanability features of tops so that they are equivalent in this characteristic to painted metal."

## Convertible top constructions and materials used

In 1955, all but one of the tops reported were of the sandwich type, the exception being a vinyl-coated cotton with no lining. In 1961 all tops were of the sandwich type. In 1955 all sandwich type tops had a cotton lining, whereas in 1961 one type of top utilized a vinyl interior.

Basically, the automobile industry used only two constructions in 1961. The predominant construction was a 4 ply structure: two outer layers of vinyl bonded with butyl rubber, a layer of cotton sheeting, and inner face (backing) material of cotton drill. Butyl rubber layers were used for bonding between layers. The inner cotton surface is treated with a water repellent compound.

The second type of construction employed a vinyl sandwich with a center layer of nylon warp, cotton fill material.

#### Price limitations on convertible top materials for compacts and standards

The cost of the most commonly used top material ranged from approximately \$3.30 to slightly over \$4.00 a lineal yard and the cost per yard did not vary in 1961 regardless of car type. In almost every case, identical materials were used in compact and standard sized models regardless of price range.

#### Trends in fiber content of convertible top materials

Four of the five companies indicated that changes in convertible top materials were quite unlikely within the next few years, because they were generally satisfied with the products in use in 1961. One company indicated a strong possibility of changing to a single ply vinyl backed with a cotton interior. This company was also investigating the possibility of using two-ply cotton-nylon blends. The only other possibilities, suggested by a company not actually anticipating a change, were new or improved vinyls and substitution of nylon or rayon for cotton backing. The latter possibilities, however, were judged to be unlikely and largely dependent upon price trends.

#### Suggestions on Ways to Improve Cotton and Wool for Use in Automobiles

In accordance with the procedure followed in 1955, the concluding question in 1961 was:

Is there anything you can think of that the laboratory might work on which would increase the use of cotton in (upholstery, sidewalls, headlining, seat padding, insulation and convertible tops)?

The same question was repeated for wool used in upholstery, sidewalls, and headlining.

#### Upholstery

Cotton: The most important suggestions received from executives for improving the position of cotton for upholstery dealt with soil resistance, wearing qualities, and color stability or some other appearance attribute.

In essence, these suggestions paralleled those offered in 1955. In both years stress was placed on research and development to improve cotton as a backing material and in blends with other fibers.

However, comments were not confined to these applications and one of the major companies had this to say about improving the future of cotton in upholstery:

"For more use you should improve its wearing qualities, its fading characteristics and its soilage and stain resistance. If in improving the wearing and fading quality of cotton there is no important loss in cotton's favorable characteristics, and the price remains competitive, we would look hard again at cotton as a surface fabric. Shrinkage in cottons is really not a problem and they are easy to work with."

Some executives were not very optimistic about cotton's future. One official asserted:

"Cotton is used now because of economy, with vinyl because it is the best backing material. But we will probably be using molded parts after about five years and until then the durability, abrasion resistance and cleanability of synthetics are so good that cotton can't hope to compete as a surface material."

"I doubt anything can be done. Cotton soils too quickly and permanently. You would have to give it the character of nylon--the same strength, color and stability."

Most of the officials, however, thought that cotton could be improved. Among suggestions were the following:

"Work with vinyl producers to develop a breathable vinyl."

"Improve cotton's color stability in blends with nylon, rayon, polypropylene, etc. The industry should explore introducing chemical changes with synthetic resins. Acetylated cotton makes for a stronger material, more susceptible to dyestuffs."

"Cotton should be made to have wear characteristics which are at least comparable to viscose. It should have added tear strength. But no improvements will have much meaning."

"Improve cotton's life and snap, make it more like nylon. Improve its cleanability and wearability."

Wool: As in 1955, the use of wool fabrics for automotive upholstery trim in 1961 was very limited.

The 1955 study revealed that almost half of the 34 executives interviewed felt that there was nothing that could be done to wool which would increase its use because of its high cost and out-of-date appearance. In 1961 there were fewer completely negative replies.

However, in both periods wool was recognized as a fiber which commands respect, has certain positive characteristics and might be desirable to use in greater quantities if improved to meet the industry's needs.

As to suggested improvements, they were similar in both years. That is, of the group who made suggestions for improvements in wool, the majority in both 1955 and 1961 stressed the point that wool would have to be developed to the point where it could compete in appearance with the modern styles and designs achieved by synthetics. Blending with other fibers was the principal method suggested for achieving these results.

In 1961 the officials suggesting improvements also stated that means would have to be found for reducing the cost of wool to a point where it is competitive with synthetics, before it would gain acceptance as an automotive upholstery material.

Others indicated that improvements must be sought in resistance to water spotting, ability to hold brilliant shades, and other characteristics available in synthetics.

The following comments were made:

"Wear characteristics alone rule wool out for the average car owner. Its resistance to water spotting must also be improved. Although we can tolerate the degree of fading encountered with wools, this is another quality that can be better. We want these improvements at prices that are comparable to those of materials of similar quality such as nylons."

"The price of wool is unstable and too high. It is less durable than synthetics at half the price and does not accept pastel colors without cracking and bleeding. Brilliant shades are not permanent in wools. Maybe they should blend wool with synthetics. The wool and leather people both don't know how to adopt and merchandise products. They send passive and expensive brochures."

"Wool has the disadvantage of clinging to the clothing, water spotting, and collecting dirt. But on the plus side it has excellent wrinkle recovery, good stretch, and is static-free. It is also a good sound deadener and doesn't reflect heat or retain the cold."

"The USDA laboratory should work on development of fabrics which contain blends of synthetic fibers and wool in order to combine the good properties of wool with the durability of synthetic fibers."

"The stylists promote wool but no one is really excited, and the cost is too high."

"Woolen filling is easy to duplicate with synthetics which wear and dye better; have better seam and tensile strength. The woolen mills tend to be small and can't handle our production needs. They are unwilling to take up new trends and can't give us the broad styling characteristics of synthetics."

"They must lower the cost to at least \$3.50 a yard level and improve styling. No effort is put into styling by the wool mills."

"They should increase the stylability to emulate nylon in patterns, etc. Wool yarns are heavy and bulky. Therefore you can't get the definition of character with wool."

### Sidewalls

Cotton: Almost unanimously in 1961 the executives discussing the future of cotton in sidewalls considered it unlikely that this material could be improved as a surface material in the foreseeable future for this application. There were, however, a few suggestions for experimental work and some suggested improvements related to cotton as a backing for vinyl. This is in contrast to the findings in 1955, when a number of suggestions were made for improving cotton as a surface sidewall material, such as greater resistance to soil and better cleanability.

In 1961 two typical comments were:

"Cotton for sidewalls needs the same improvements as for upholstery (cleanability, wearability) but we still wouldn't use cotton as a 'face' material because of soiling. If cotton cloth could be improved to have the feel of nylon and the characteristics and cost of vinyl-- we might use cotton."

"We are not interested in duplicating upholstery fabrics on sidewalls. If we did decide to duplicate we could do so with a printed vinyl and/or a lower cost fabric. We don't need tensile strength for sidewalls."

Among the positive comments on improving cotton for sidewall surfaces were the following:

"They might develop a cotton which has a coating making it abrasion resistant. It might be cheaper and faster if we could use printed cottons instead of embossed vinyls that have the appearance of other fabrics in the car."

"Develop new nonwoven or chemically modified products using cotton fibers. Develop materials which have superior dielectric properties by means of chemical additives. Improve the cloth's hardening properties."

With regard to improvements in cotton as a backing material one industry representative made the following statement:

"Make cotton backing cheaper. Several mills are also working on nonwoven fibers that are bonded with resins. This will provide adequate stretch characteristics."

Wool: Virtually all of the executives stated that further laboratory work would not help to increase use of wool as a sidewall fabric. The prevailing opinion among these executives was that, regardless of laboratory work, wool is too costly.

One executive typified the attitude toward wool sidewall materials with the statement:

"We are not interested. The cost is out of the question. See the people who manufactured high-priced cars, not us."

### Headlining

Cotton: As in 1955 a substantial majority of the suggestions offered with respect to headlining stressed the need for improving cotton's soil resistance and cleanability.

In addition, the executives of one company asked for improved stretch properties through the use of cotton backing in "other than woven form," and another official suggested development of "suitable blends of wool, cotton, and synthetics incorporating chemical research for possible molded unitized assemblies."

Among the comments on improvements in cotton headlining cleanability and soil resistance were:

"The cotton suppliers have tried to improve its cleanability without success."

"It's not worth research dollars to solve the cleanability problem (of cotton) because other products are satisfactory."

It is of interest to note that in 1955 a typical comment on cotton headlining warned that unless cotton's soil resistance, cleanability, and stylishness could be improved at no additional cost, "it would soon be replaced as a (surface) headlining fabric;" a prediction largely borne out by 1961.

Other suggestions regarding cotton for headlining included improving:

- Fire retardant qualities
- Resistance to water staining and wicking
- Resistance to tar staining (which results from bleeding of sound insulator in hot weather)
- Cost to equal vinyl (because the need to nap and shear cotton for the sake of appearance adds to its cost)
- Resistance to mildew

Wool: According to virtually all of the executives interviewed in 1961, only lower prices could induce the use of wool as a headlining material.

Executive groups in two companies asserted that wool was undesirable because of its appearance and lack of stain resistance. As in 1955, the majority felt that the laboratory could do little to enhance wool's position for headlining.

### Convertible tops

Cotton: Representatives in all of the five companies interviewed had suggestions for improvements which might increase the use of cotton for convertible tops. Most of their attention appeared to be directed toward problems dealing with resistance to aging under adverse weather conditions. This is in contrast to 1955 when primary attention was focused on color problems. The change reflects important modifications in industry practice between 1955 and 1961. On the one hand vinyl has come into general usage as an outer surface and on the other hand, the cotton used as an inner surface is commonly black to avoid the color problem.

The most usual suggestion for improvement in cotton related to water staining or wicking on the inside surface. Other suggestions included improved resistance to rot and mildew, easier inside cleanability, better dimensional stability (less shrinkage), increased acid resistance, better strength-to-weight ratios and blends of cotton with synthetics to provide the best qualities of both materials.

Representative comments on improvements in cotton for convertible tops were:

"Top materials would be improved if the cotton were more soil resistant, more cleanable, and more mildew resistant, especially after two or three years in a climate like that in New Orleans. Perhaps this might be achieved with a slight vinyl spraying or coating."

"The laboratory should try to increase acid resistance and increase strength per cross sectional area so that we have a stronger fabric for less weight. However, cotton is an ideal material now. When it gets wet it increases its strength; has excellent dielectric strength; can be treated to resist mildew."

"Cotton backing needs improvement to overcome the wicking problem. Every stain shows. That is why the color black is used on the interior. To use it for the outside surface it would have to be made as good as, or better than vinyl."

"The laboratory should help reduce the shrinking characteristics of cotton fabrics."

### Seat padding

Cotton: Of the 15 executives answering this question, 7 stated that the laboratories could not develop cotton to a point where it would be as desirable

as foam rubber for padding purposes. Typically, the comments expressed this attitude:

Foam rubber is inherently a much better padding material than cotton. It is soft, resilient, and has sales appeal. The development work on cotton has not produced the desired resiliency.

All of the recommendations for laboratory work involved development of a cotton padding with greater resiliency and resistance to set. Another suggestion was to lessen moisture absorption.

Typical comments on cotton padding improvements were:

"Cotton's susceptibility to humidity must be overcome. Cotton specifications are harder to control than foam. There is more of a human element in cotton. The way it has been combed may affect its ability to conform to body contours. It is very difficult to form. They should try to combine cotton and synthetics to provide a formed cotton. I believe the industry group is working on that now."

"The laboratory should improve the resiliency and recovery properties of cotton padding, as well as blends of cotton with synthetic fibers and resins."

"Cotton is most unsatisfactory because it has no recovery. You have to have too much mass and height to achieve resiliency. Perhaps they could spray urethane on cotton to develop a stable resilient pad."

"Cotton padding needs greater resiliency; no 'set.' It should be made odor-free. Cotton smells when it gets wet in steaming for trimming."

#### Thermal and sound insulation

Cotton: Among the executives interviewed in this respect, the most common recommendation which arose was to make cotton as good and as cheap as other insulating materials. It was pointed out that cotton and other organic fibers are at a disadvantage when it comes to fire retardant qualities which are apt to be required for both thermal and sound insulators. A typical insulating engineer comment with respect to improving cotton as an insulator was:

"The problem would be to show how cotton meets the functional advantages of other materials at a competitive price."

A small number of more specific suggestions were made, however, including:

Elimination of matting  
Development of readily applied forms

Bacteria resistance  
Development of properties similar to Tufflex (wood fibers)  
Pads using cotton as a filter with fiberglass-like characteristics  
Development of fiberglass-like characteristics in general

## APPENDIX

### Explanation of the term "price class of car"

To clarify references to this and related terms used in the text, the following detail should prove helpful.

Make of car applies to a specific car brand name. If a corporation has 5 makes, 1 may be considered low-priced; 2, medium-priced; 2, high-priced.

Each make may be produced in various lines. As in the case of make, the basic distinction among lines is usually price, which increases as mechanical, styling, and trim embellishments are added.

Models within each line include those known as 2-door, 4-door, hardtop convertibles, and station wagons.

However, because the price of a high-priced line within a low-priced make may exceed the price of a low-priced line within a medium-priced make, the selling price alone was not considered suitable for classification purposes for this study. Instead the manufacturer's concept of the "price class" of the make was used because executives discussed variations in price class from this general point of view.







NATIONAL AGRICULTURAL LIBRARY



1022831127